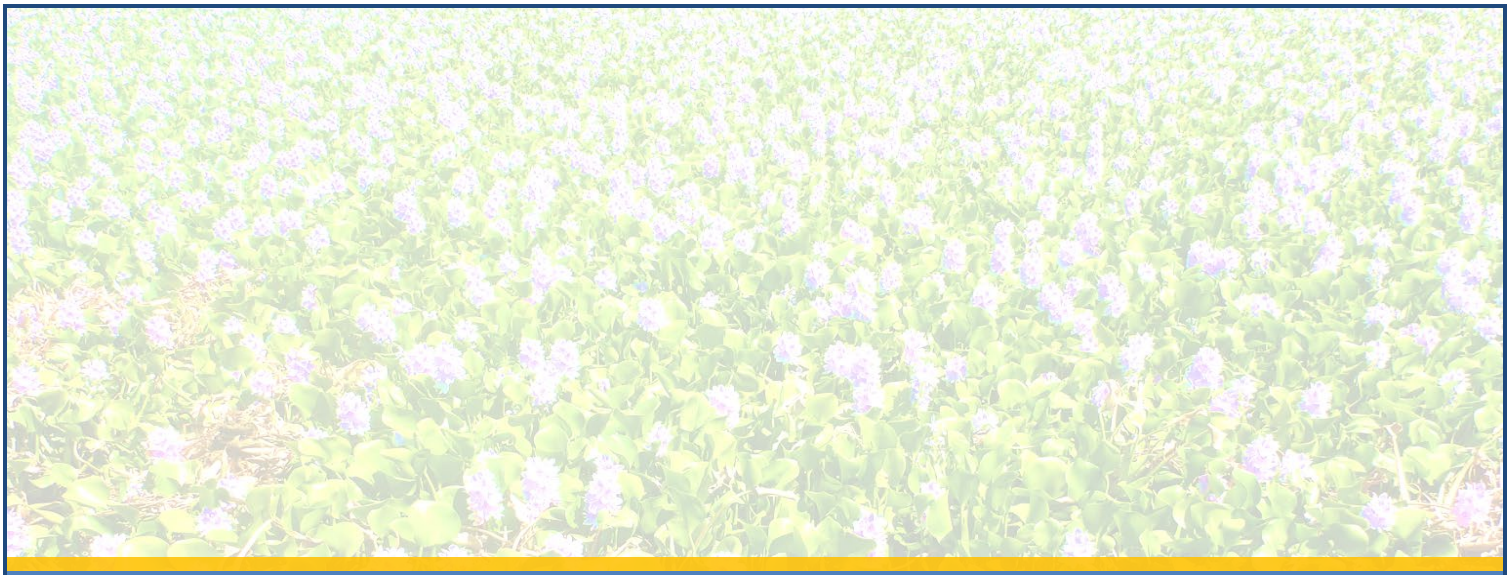


Floating Aquatic Vegetation Control Program

Water hyacinth | South American Spongeplant | Alligatorweed

Uruguay Water Primrose

2018 Annual Monitoring Report

California Department of Parks and Recreation

Division of Boating and Waterways

September 2019

Submersed Aquatic Vegetation Control Program

2018 Annual Monitoring Report

Submitted Pursuant to:

- State Water Resources Control Board Statewide General National Pollutant Discharge Elimination System Permit (CAG990005)
- United States Fish and Wildlife Service (USFWS) Biological Opinion (08FBDT00-2013-F-0005)
- National Marine Fisheries Service (NMFS) Letter of Concurrence (2013/9391)
- 40 CFR 122.41 (k) and 40 CFR 122.21

I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate information submitted. Based on my inquiry of the persons who manage the program, Edward Hard, *Environmental Program Manager* and Patricia Gilbert, *Senior Environmental Scientist*, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.

10/29/19

Ramona Fernandez, Acting Deputy Director
California Department of Parks and Recreation
Division of Boating and Waterways

Date

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

ACRONYMS AND ABBREVIATIONS

2,4-D – 2,4-dichlorophenoxyacetic acid
AIS - Aquatic Invasive Species
APAP – Aquatic Pesticide Application Plan
BMP – Best Management Practices
BO – Biological Opinion
CDFW – California Department of Fish and Wildlife
COLD – Cold Freshwater Habitat
CVP - Central Valley Project
CVRWQCB – Central Valley Regional Water Quality Control Board
CY - cubic yards
DBW – Division of Boating and Waterways
Delta – Sacramento-San Joaquin Delta
DO – Dissolved Oxygen (measured in mg/l or ppm)
DPS – Distinct Population Segment
DSRS – Delta Smelt Resiliency Strategy
DRAAWP – Delta Regional Area Wide Aquatic Weed Project
EDCP - *Egeria densa* Control Program
EPA – United States Environmental Protection Agency
ESA – Endangered Species Act (federal)
FAV – Floating Aquatic Vegetation
GIS - Geographic Information System
GGS – Giant Garter Snake
HPLC – High Performance Liquid Chromatography
IEP – Interagency Ecology Program
NASA – National Aeronautics and Space Administration
NMFS – National Marine Fisheries Service
NOAA – National Oceanic and Atmospheric Administration
ND – No Detection/Non-detect
NOI – Notice of Intent
NPDES – National Pollution Discharge Elimination System
NTU – Nephelometric Turbidity Units
OMP – Operations Management Plan
ppb – Parts per Billion (µg/l)
QAC – Qualified Applicator Certificate
QAPP – Quality Assurance Project Plan
SAV – Submersed Aquatic Vegetation
SCP – Spongeplant Control Program
SPWN – Spawning, Reproduction and/or Early Development
SWP - State Water Project
SWRCB – State Water Resources Control Board
USDA-ARS – United States Department of Agriculture – Agricultural Research Service
USFWS – United States Fish and Wildlife Service
UTM – Universal Transverse Mercator
VELB – Valley Elderberry Longhorn Beetle
WARM – Warm Freshwater Habitat
WHCP – Water Hyacinth Control Program
WSID - West Side Irrigation District

EXECUTIVE SUMMARY

This annual report provides an overview on the progress of and activities conducted by the Floating Aquatic Vegetation (FAV) Control Program under the Aquatic Invasive Plant Control Program (AIPCP) in the Aquatic Invasive Species (AIS) Branch of the California Department of Parks and Recreation Division of Boating and Waterways (DBW) during the 2018 calendar year in the Sacramento-San Joaquin Delta (Delta) and tributaries – the San Joaquin River, Tuolumne River and Merced River.

Invasive aquatic plants can rapidly displace native species, clog water conveyance systems, form dense monospecific stands that restrict water movement, trap sediment, provide habitat for mosquitos and cause fluctuations in water quality. Dense growth may interfere with recreational uses of a waterbody and with navigation.

For the 2018 season, DBW was allowed to treat up to 4,500 acres of FAV within 418 sites. A total of 2,557 acres of water hyacinth (*Eichhornia crassipes*), South American spongeplant (*Limnobium laevigatum*), Uruguay waterprimrose (*Ludwigia hexapetala*) and alligatorweed (*Alternanthera philoxeroides*) were treated.

Treatment metrics included:

- 2,528 gallons of glyphosate
- 960 gallons of 2,4-D
- 242 gallons of imazamox
- 1,585 gallons of Agridex
- 128 gallons of Competitor
- Mechanically harvested 15,650 cubic years or 9.7 acres of FAV.
- Treated all known patches of Alligatorweed in the Delta.
- All fish passage protocols were followed.

Water samples and water quality measurements were collected per the National Pollution Discharge Elimination System (NPDES) monitoring requirements. DBW monitored four (4) sites within the legal Delta. Herbicide residues were analyzed in receiving waters and water quality parameters, such as dissolved oxygen, temperature, conductivity, salinity, pH, and turbidity, were measured at representative locations. Any occurrences where dissolved oxygen levels, turbidity and pH exceeded limits in the Water Quality Control Plan (Basin Plan) for the Sacramento and San Joaquin River Basins established by the Central Valley Regional Water Quality Control Board (CVRWQCB) were expected to be temporary given the diurnal tidal movements of the Delta, varying hydrodynamics, and periodic mixing of the water column. There was no field evidence to suggest a correlation with DBW's FAV Control Program operations.

In addition, there were no observations of injured or impacted species of concern during follow-up site surveys. No incidental take of threatened or endangered species occurred during the 2018 season.

All herbicide residue concentrations at receiving water locations were either not detected or were below receiving water limits as specified in the NPDES permit.

DBW also continued work with its mechanical harvesting efforts for FAV from waterways of the Delta that were identified as being a nursery site or having high infestations of water hyacinth, spongeplant and/or water primrose. Locations for 2018 included Fourteenmile Slough, West Side Irrigation District (WSID), Fabian Tract, and Rivers End/Old River. A combination of harvesting equipment, excavators, and dump trucks were used by contractors to harvest and remove FAV from the water, and transport plants to an approved spoils site for drying and decay. Approximately 15,650 cubic yards, or roughly 9.7 acres, of FAV were controlled by mechanical means between March 19, 2018 and Dec. 27, 2018.

The division takes very seriously its responsibility to lead in the control of invasive aquatic plants in the Delta and to protect this estuary against adverse impacts on the environment, agriculture, public health and water quality. DBW adheres to strict guidelines from local, state and federal entities to ensure that the Delta is protected from the use of herbicides. Treated areas are monitored to ensure herbicide levels do not exceed allowable limits.

The division follows mutually agreed upon protocols/conditions outlined in BOs approved by the U.S. Fish and Wildlife Service (USFWS) and National Marine Fisheries Service (NMFS). The BOs are designed to protect endangered species, guide acreage treated, specify the kinds of treatment used, including which herbicides and what species to control, and treatment dates. Protocols regarding the levels of herbicides to use and requirements for extensive water quality and environmental monitoring are also part of the BOs. Treated areas are monitored to ensure herbicide levels do not exceed allowable limits.

Additionally, DBW's control program obtains a Lake and Streambed Alteration Agreement from California Department of Fish and Wildlife (CDFW) for mechanical harvesting efforts. For herbicide treatment, the division obtains a Clean Water Act permit from the State Water Resources Control Board (SWRCB) and pesticide use permits and notices from the County Agricultural Commissioner's offices.

Annual required trainings are carried out to ensure applicator staff are well versed in the herbicides being used, as well as safety protocols and methods for minimizing impacts on the environment.

The FAV program operates an extensive water quality-monitoring program to ensure compliance with all water quality standards, including drinking water standards. All water quality monitoring followed the NPDES Annual Monitoring Protocol as outlined in the Aquatic Pesticide Application Plan, which was approved in 2014 by the SWRCB.

A key element of DBW's monitoring program is ongoing collaboration with regulatory entities and reviewing new information that may inform and improve control programs. The division will continue to work with its partners to better understand the invasive aquatic plants, implement new integrated strategic methods and increase efficacy. Additionally, DBW will continue to adhere to the strict guidelines outlined in BOs that it receives from regulatory entities to ensure the Delta's natural resources and water quality are protected.

1 INTRODUCTION

DBW is the designated lead state department for controlling water hyacinth (*Eichhornia crassipes*), South American spongeplant (*Limnobium laevigatum*), alligatorweed (*Alternanthera philoxeroides*) and Uruguay water primrose (*Ludwigia hexapetala*), which are non-native, invasive, floating, aquatic plants (Appendix F). These plants can have negative impacts on the environment, economy, and public health. More specifically, they can destabilize dissolved oxygen cycles, crowd out native plants, shade out important shallow water fish habitat, influence water flows, obstruct waterways and navigational channels, and block agricultural and municipal water intakes.

In 1982, Senate Bill 1344 (Garamendi and Nielsen, Ch. 263, Statutes of 1982), Chapter 2, Article 2, Section 64 amended the statutes of the California Harbors and Navigation Code to designate DBW as the lead agency for controlling water hyacinth in the Delta, its tributaries, and the Suisun Marsh. As a result, the Water Hyacinth Control Program (WHCP) was established in 1983.

DBW implemented the *Egeria densa* Control Program (EDCP) in 2001 (now called Submersed Aquatic Vegetation [SAV] Control Program as of 2016). Significant input has been provided to assist DBW with the planning process and decision-making by USDA-ARS through research and technical expertise.

In 2012, Assembly Bill 1540 (Buchanan, Ch. 188, Statutes of 2012) was passed to add spongeplant control to DBW's jurisdiction. Thus, the Spongeplant Control Program (SCP) was established.

In 2013, Assembly Bill 763 (Buchanan, Ch. 330, Statutes of 2013) was passed to address the need for a holistic approach to manage aquatic invasive plants in the Delta. The bill mandated greater coordination among local, state, federal and private boating interests in the Delta to identify new plant species through a risk assessment based process to manage invasive aquatic plants (see Section 2 for additional information on legislation).

1.1 Extent of Infestation

The Delta and its tributaries contain 67,779 water surface acres, all of which may potentially provide habitat for FAV.

Water hyacinth coverage estimates in the Delta, since 1981, have ranged from less than 500 acres up to approximately 2,500 acres (DBW 2012). This wide range of annual water hyacinth acreage in the Delta is dependent upon many factors, including acreage treated, timing of treatments, seasonal air and water temperatures, water flows, water levels, and rainfall. During the 2016-2017 winter, an increase in precipitation and water flows flushed large concentrations of water hyacinth out of the Delta and towards marine waters.

In 2007, South American spongeplant was identified in the Delta near Antioch and found again in following years, spreading to several other locations within the Delta. Based on DBW's observations and surveys, spongeplant distributions continued to expand increasingly throughout the Delta between 2013 and 2018. In 2018, spongeplant was observed in many sites of the Delta that contained either small amounts of individual plants or larger infestations.

Uruguay water primrose can be found throughout the Delta, often observed in competition with water hyacinth and native floating pennywort (*Hydrocotyle ranunculoides*). DBW staff have observed that water primrose coverage has expanded significantly in the Delta in recent years. In 2017, this expansion was exacerbated by the increase in precipitation and water flows which flushed out water hyacinth and created empty niches for water primrose.

Determining the annual extent of infestation of invasive FAV in the Delta and its tributaries can be difficult because both individual plants and large mats can move with river currents, diurnal tidal movement, and winds. Historically, pre- and post-season infestations have been assessed through visual estimates conducted by DBW field staff. However, remote sensing efforts have assisted with tracking FAV distributions.

Through a partnership with National Aeronautics and Space Administration (NASA), as a part of the U.S. Department of Agriculture – Agricultural Research Service (USDA-ARS) Delta Regional Areawide Aquatic Weed Project (DRAAWP), NASA has provided DBW with map imagery from Landsat satellite data that depicts live water hyacinth and water primrose acreage of areas that have high probability of experiencing > 50 percent coverage of FAV in Delta waterways. Imagery was provided on a monthly basis to DBW, weather permitting since cloud cover can impact the satellite image.

Aerial flight imagery was also obtained through contractual efforts between DBW and Tetra Tech for various sites in the Delta. This data was primarily utilized to survey specific sites that were in need of more monitoring, were historically or presently problematic, and/or require or have received mechanical control. Tools and methodologies for further processing and analysis of this aerial flight imagery, such as vegetation classification via spectral signatures or reflectance, began in 2017 and will continue to be developed and refined for potential future use and integration into the FAV Control Program.

1.2 Setting

The FAV Control Program area of operation includes portions of eleven counties that encompass the Delta and its upland tributaries. The eleven counties include Alameda, Contra Costa, Fresno, Madera, Merced, Sacramento, San Joaquin, Solano, Stanislaus, Tuolumne and Yolo. General boundaries for the treatment area in the Delta and its tributaries are as follows:

- West up to and including Sherman Island, at the confluence of the Sacramento and San Joaquin Rivers.
- West up to the Sacramento Northern Railroad to include water bodies north of the southern confluence of the Sacramento River and Sacramento River Deep Water Ship Channel.
- North to the northern confluence of the Sacramento River and Sacramento River Deep Water Ship Channel, plus waters within Lake Natoma.
- South from Clifton Court along Old River to Mossdale, and continuing along the San Joaquin River to Mendota, just east of Fresno.
- East along the San Joaquin River to the city of Stockton, continuing east along the San Joaquin River to Friant Dam on Millerton Lake.
- East along the Tuolumne River to La Grange Reservoir below Don Pedro Reservoir.
- East along the Merced River to Merced Falls, below Lake McClure.

Within the 2018 FAV Control Program's project area, there are 418 possible treatment sites. These sites vary in size (between 5 and 1,700 acres) and may be between one and three miles in length. See Figures A-1, A-2, and A-3 in Appendix A for maps of the FAV Control Program's project area and monitoring sites sampled in 2018.

2 LEGISLATION

2.1 Section 64 of the Harbors and Navigation Code

SB 1344 (Garamendi and Nielsen, Ch. 263, Statutes of 1982) amended Section 64 of the Harbors and Navigation Code to read as follows:

"(a) The Legislature hereby finds and declares that the growth of water hyacinth (*Eichhornia crassipes*), Brazilian elodea (*Egeria densa*), and South American spongeplant (*Limnobium laevigatum*) in the Sacramento-San Joaquin Delta, its tributaries, and the Suisun Marsh has occurred at an unprecedented level and that the resulting accumulations of water hyacinth, *Egeria densa*, and South American spongeplant obstruct navigation, impair other recreational uses of waterways, have the potential for damaging manmade facilities, and may threaten the health and stability of fisheries and other ecosystems within the delta and marsh. Accordingly, it is necessary that the state, in cooperation with agencies of the United States, undertake an aggressive program for the effective control of water hyacinth, *Egeria densa*, and South American spongeplant in the delta, its tributaries, and the marsh."

"(b) The Division is designated as the lead agency of the state for the purpose of cooperating with agencies of the United States and other public agencies in controlling water hyacinth, *Egeria densa*, and South American spongeplant in the delta, its tributaries, and the marsh."

AB 763 (Buchanan, Ch. 330, Statutes of 2013) amended Section 64 of the Harbors and Navigation Code as follows:

"This bill would additionally designate the Division as the lead agency of the state for the purpose of cooperating with other state, local, and federal agencies in identifying, detecting, controlling, and administering programs to manage invasive aquatic plants, as defined, in the Sacramento-San Joaquin Delta, its tributaries, and the Suisun Marsh."

Section 64.5 of the Harbors and Navigation Code is amended to read as follows:

"(a) The Division is designated as the lead agency of the state for the purpose of cooperating with other state, local, and federal agencies in identifying, detecting, controlling, and administering programs to manage invasive aquatic plants in the Sacramento-San Joaquin Delta, its tributaries, and the Suisun Marsh. The Division, in consultation with appropriate state, local, and federal agencies, may take such action it determines is necessary, upon concurrence from the Department of Fish and Wildlife following the completion of the risk assessment described in subdivision (c), to implement control and, when feasible, eradication measures for invasive aquatic plants. Any actions taken to control invasive aquatic plants shall be in compliance with all applicable laws and regulations and conducted in an environmentally sound manner."

"(b) The Division shall regularly consult with the United States Department of Agriculture, the United States Fish and Wildlife Service, the National Oceanic and Atmospheric Administration, the University of California, and other members of the scientific and research communities, as well as other state agencies with authority over the control of invasive aquatic plants to determine which species of those plants should be given the highest

priority for management and determine the best control and, when feasible, eradication measures."

"(c) (1) After consulting with the various entities as required in subdivision (b), if the Division identifies a species of aquatic plant that may be invasive and need to be controlled or eradicated, the division shall notify the Department of Fish and Wildlife of the potential threat from that aquatic plant species. After receipt of that notice, the Department of Fish and Wildlife, in consultation with other appropriate local, state, and federal agencies, including, but not limited to, the Department of Food and Agriculture, the Department of Water Resources, the State Water Resources Control Board, the Department of Pesticide Regulation (CDPR), and the Office of Environmental Health Hazard Assessment, shall conduct a risk assessment of the aquatic plant species identified by the Division to determine whether the plant species is invasive and presents a threat to the environment, economy, or human health. In making that determination, the Department of Fish and Wildlife shall take prompt action to minimize detrimental impacts and costs of management, and shall consider all of the following:

(A) Whether the aquatic plant species may obstruct navigation and recreational uses of waterways.

(B) Whether the aquatic plant species may cause environmental damage, including threats to the health and stability of fisheries, impairment to birds' access to waterways and nesting, roosting, and foraging areas, deterioration of water quality resulting from plant decay, and harm to native plants.

(C) Whether the aquatic plant species may cause harm to the state's economy, infrastructure, or manmade facilities such as state water storage facilities and pumping operations, by increasing flood risk, threatening water supplies by blocking pumps, canals, and dams necessitating early control efforts.

(2) Based on factors specified in subparagraphs (A), (B), and (C) of paragraph (1) and any other environmental, economic, or human health impacts, the risk assessment shall specify whether the plant species under consideration has been determined to be an invasive aquatic plant. Findings from the risk assessment shall be documented in a way that clearly describes the severity and types of impacts caused by a plant species determined to be an invasive aquatic plant.

(3) Within 60 days after completing the risk assessment required by paragraph (1), the Department of Fish and Wildlife shall report its findings to the division so that the division may take any necessary action to control and, when feasible, eradicate an invasive aquatic plant, as authorized under subdivision (a).

(d) For purposes of this section, "invasive aquatic plant" means an aquatic plant or algae species, including its seeds, fragments, and other biological materials capable of propagating that species, whose proliferation or dominant colonization of an area causes or is likely to cause economic or environmental harm or harm to human health.

(e) Aquatic plants shall be determined to be invasive through the risk assessment required to be completed by the Department of Fish and Wildlife in consultation with the division and other state, local, and federal agencies pursuant to subdivision (c)."

2.3 Risk Assessment Status

The CDFW administers the risk assessment process to determine whether a species can be considered an invasive species in California. CDFW uses the U.S. Aquatic Weed Risk Assessment tool to evaluate aspects of a species' ecology, reproductive potential, dispersal mechanisms, competitive ability, actual and potential impacts (including impacts to navigation and recreation, the environment, economy, and human health as specified in Harbors and Navigation Code 64.5), and resistance to management. Based on this evaluation, CDFW, in consultation with the DWR, SWRCB, CDFA, CDPR, and Office of Environmental Health Hazard Assessment (OEHHA), and in concurrence with DWR will make a determination whether the species is an invasive aquatic plant that causes, or is likely to cause, economic or environmental harm, or harm to human health in California. The scoring system is broken into three categories, non-invaders score < 31, scores of 31 – 39 require further evaluation, and any species with a score > 39 is considered a major invader. Table 1 shows the risk assessment determination for each species.

Table 1 – Risk Assessment Scores for FAV

Common Name	Scientific Name	Score	Date of Determination
water hyacinth	*Eichhornia crassipes*	*	
South American spongeplant	*Limnobium laevigatum*	*	
Uruguay water primrose	*Ludwigia hexapetala*	76	July 22, 2016
floating pennywort	*Hydrocotyle ranunculoides*	N/A	*In process*
alligatorweed	Alternanthera philoxeroides	74	March 1, 2018

**Determined to be an invasive in 1982, prior to the use of this scoring tool.*

In 2016, the CDFW completed a risk assessment for Uruguay water primrose and concluded that "Uruguay water primrose should be considered an invasive aquatic plant that causes or is likely to cause economic or environmental harm or harm to human health in California." Accordingly, DBW added water primrose to the existing control program and began treatments in September 2016. With the addition of water primrose to the program, the WHCP and SCP have been renamed to the Floating Aquatic Vegetation (FAV) Control Program.

In 2018, the CDFW completed a risk assessment for alligatorweed and concluded that "alligatorweed should be considered an invasive aquatic plant that causes or is likely to cause economic or environmental harm or harm to human health in California."

3 ENVIRONMENTAL COMPLIANCE

3.1 Summary of Regulatory Compliance Requirements

The following constitutes a summary of the environmental compliance documents required to implement the FAV Control Program. Each document has requirements designed to ensure avoidance or minimization of significant impacts to beneficial uses of waters of the U.S., federally threatened and endangered species, or state threatened and endangered species protected by the Endangered Species Act (ESA). DBW partners with the USDA-ARS as a federal nexus to obtain required approvals to operate the FAV Control Program from two federal agencies: USFWS and NMFS.

The division obtained multi-year (2013-2018) authorizations from USFWS and NMFS to operate the FAV Control Program pursuant to Section 7 of the ESA.

- USFWS BOs:
  - 81410-2013-F-0005, effective March 13, 2013
  - 08FBDT00-2014-F-0029, effective Aug. 11, 2014
  - Extension (08FBDT00-2013-F-0015), effective Feb. 13, 2018
  - 08FBDT00-2018-F-0029, effective April 3, 2019
- NMFS Letters of Concurrence
  - 2013/9443, effective Feb. 27, 2013
  - 2014-394, effective May 28, 2014
  - 2017-8268, effective May 15, 2018

An NPDES permit is required by the SWRCB. It is referenced as the Statewide General NPDES Permit for the Discharge of Aquatic Pesticides for Aquatic Weed Control in Waters of the United States (Permit No. CAG990005, Water Quality Order 2013-0002-DWQ). Coverage under this permit was obtained in January 2014 and expires on Nov. 30, 2018.

DBW is currently in operating under previous Permit No. CAG990005 and waiting for new permit from SWRCB.

In addition, a Streambed Alteration Agreement (or Routine Maintenance Agreement) was entered into between DBW and CDFW for mechanical removal and harvesting efforts of FAV (Notification No. 1600-2015-0132-R3). The agreement became effective Oct. 23, 2015 and will expire on Dec. 31, 2019.

3.1.1 Reporting Requirements

The NPDES Statewide General Permit for Aquatic Pesticide Use requires DBW to submit an annual report March 1 following the FAV application season. Reporting per NPDES guidelines must include the following:

1) Executive summary discussing permit compliance or violation of permit terms and conditions to beneficial waters of the U.S.

2) Effectiveness of the Aquatic Pesticide Application Plan (APAP) to reduce or prevent the discharge of pollutants associated with aquatic pesticide applications.

3) Summary of monitoring data, including changes to water quality, and violations of compliance with water quality objectives as outlined in the Water Quality Control Plan (Basin Plan) for the Sacramento River and San Joaquin River Basins issued by the CVRWQCB.

4) Identification of Best Management Practices (BMPs) and their effectiveness in meeting permit requirements.

5) Discussion of modifications or management corrections for any violations that occurred.

6) Maps showing application area, acreage and sampling locations, types and amounts of aquatic pesticides used during each application event, information on surface area, volume and rate of application.

7) Sampling results for all required monitoring.

Both the USFWS BOs and the NMFS Letters of Concurrence require annual reports to be submitted on January 31, following the application season. These reports summarize compliance with the terms and conditions which include species and habitat protection, water quality monitoring, and any additional monitoring and studies. Additional reporting requirements are on a case-by-case basis in the event an incidental take should occur with any of the species discussed in the USFWS BOs. Take is defined as “to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect, or to attempt to engage in any such conduct.” Reporting of take begins with immediate notification to the USFWS biologist (based on jurisdiction) in charge of administering the BO and requires documentation of information, such as location of take, number of species, water quality conditions, chain of custody, and prescriptive action for preventing future occurrences.

3.1.2 Statewide General NPDES Permit

RECEIVING WATERS

There are clear definitions in the NPDES Permit (No. CAG990005, Water Quality Order 2013-0002-DWQ) regarding application area, treatment area, and receiving waters. In the NPDES Permit, an *application area* is defined as the area in which aquatic pesticides are directly applied. The *treatment area* is the area treated with an aquatic herbicide to control invasive aquatic plants. It is the responsibility of the discharger to define the treatment area for each location that it discharges to. The FAV Control Program sprays herbicide directly onto water hyacinth, spongeplant, water primrose, and/or alligatorweed and does not inject herbicides into the water column to treat submersed plants. Therefore, considering the NPDES definitions, the application and treatment areas are essentially the same geographic place in relation to the FAV Control Program. Receiving waters are defined in two manners: 1) waters directly down flow of the treatment area, and 2) waters within the treatment area after completion of the treatment event when herbicide residue levels fall below minimum effective concentrations. Herbicides applied to aquatic plants are not considered a pollutant until residues reach receiving waters. This is because an herbicide designed to treat aquatic plants and approved by the United States Environmental Protection Agency (US EPA) cannot also be a pollutant under the Clean Water Act when the herbicide is doing what it was designed and approved to do under federal pesticide use regulations.

NUMERIC LIMITS

Dissolved Oxygen

Dissolved oxygen (DO) limits are outlined in the Sacramento River and San Joaquin River Basin Plan issued by the CVRWQCB and subsequently required under the NPDES permit. Within the legal boundaries of the Delta, the DO concentration shall not be reduced below:

- 7.0 mg/l in the Sacramento River (below the I Street Bridge) and in all Delta waters west of the Antioch Bridge
- 6.0 mg/l in the San Joaquin River (between Turner Cut and Stockton, 1 September through 30 November)
- 5.0 mg/l in all other Delta waters

For surface water bodies outside the legal boundaries of the Delta, the monthly median of the mean daily DO concentration shall not fall below 85 percent of saturation in the main water mass, and the 95 percentile concentration shall not fall below 75 percent of saturation. To protect beneficial uses of water, the dissolved oxygen concentrations shall not be reduced below the following minimum levels at any time:

- 5.0 mg/l for waters designated as warm freshwater habitat (WARM)
- 7.0 mg/l for waters designated as cold freshwater habitat (COLD)
- 7.0 mg/l for waters designated for spawning, reproduction, and development (SPWN)

In the locations listed in Table 1, dissolved oxygen concentrations shall not be reduced below the amount indicated during the stated time period.

Table 1. Specific Dissolved Oxygen Water Quality Objectives

Location	DO concentration	Time Period
Merced River from Cressy to New Exchequer Dam	8.0 mg/l	All year
Tuolumne River from Waterford to La Grange	8.0 mg/l	15 October to 15 June

pH and Turbidity

In addition to DO limits, basin limits for pH and turbidity are also described in the Basin Plan and required under the NPDES permit. The discharge shall not cause the ambient pH to fall below 6.5 or exceed 8.5, and/or cause turbidity to increase as follows:

- More than 1 Nephelometric Turbidity Units (NTU) where natural turbidity is between 0 and 5 NTUs
- More than 20 percent where natural turbidity is between 5 and 50 NTUs
- More than 10 NTUs where natural turbidity is between 50 and 100 NTUs
- More than 10 percent where natural turbidity is over 100 NTUs

The Basin Plan also outlines general turbidity objectives for Delta waters: except for periods of storm runoff, the turbidity of Delta waters shall not exceed 50 NTUs in the waters of the Central Delta and 150 NTUs in other Delta waters.

3.1.3 USFWS BOs for FAV

The USFWS issued BOs on the effects of DBW's FAV Program on delta smelt (*Hypomesus transpacificus*) and its critical habitat, giant garter snake (*Thamnophis gigas*), and the valley elderberry longhorn beetle (*Desmocerus californicus dimorphus*). The FAV Program complies with the USFWS BO terms and conditions which include implementation of conservation measures identified in the FAV Program description. Below is a summary of the terms and conditions required under the BO.

DELTA SMELT

The USFWS BO outlines specific mitigation measures to minimize impact delta smelt and associated habitats. Interagency Ecological Program (IEP) fish monitoring data is used to determine the presence or absence of delta smelt within or near herbicide application areas. The timing and location requirements that are specified in the USFWS BO aim to reduce the potential for negative impacts on delta smelt. The FAV Program area is divided into four USFWS Areas (Figures A-2, and A-3, in Appendix A): Area 1 (primary delta smelt habitat), Area 2 (secondary delta smelt habitat), Area 3 (tertiary delta smelt habitat) and Area 4 (non-delta smelt habitat). Herbicide applications in Area 2, 3 and 4 sites may begin on March 1 and continue through November 30. Herbicide applications in Area 1 sites may begin June 1 and continue until November 30. For all treatments conducted between March 1 and June 30, the ability to treat FAV depends on the presence of listed fish species, which is determined by a review of available fish monitoring data and by species surveys on the day of the planned treatment. Herbicide applications will be suspended in the immediate treatment area in the event that delta smelt are identified, harmed or killed in the action area.

The USFWS BO requires that personnel involved with the FAV Control Program receive USFWS-approved worker environmental awareness training. Under this training program, personnel are informed about the presence of delta smelt and its associated habitat. Training includes 1) species identification, 2) the life history of delta smelt, 3) the importance of Delta migratory routes, and 4) all terms and conditions of the USFWS BO for protection, avoidance and minimization of impacts to protected species under ESA.

VALLEY ELDERBERRY LONGHORN BEETLE

The USFWS BO outlines specific mitigation measures to minimize impact to the valley elderberry longhorn beetle (VELB) and associated elderberry shrub (*Sambucus* sp.) habitat. DBW was directed by USFWS to avoid impacts to VELB by surveying for elderberry shrubs, and maintain a 100-foot buffer between treatment sites and shoreline elderberry shrubs. In areas where treatment cannot occur away from VELB habitat and where a 100-foot buffer would preclude DBW's ability to treat floating invasive aquatic plants, DBW will use a 50-foot buffer when winds are less than 3 mph. In addition, wind speed and direction are also factors as to whether or not a treatment could occur in these areas. Herbicide applications occur away from and downwind of elderberry shrubs.

The USFWS BO requires that personnel involved with the FAV Control Program receive worker environmental awareness training taught by a USFWS-approved biologist. Under this

training program, personnel are informed about the presence of VELB and its habitat. Training includes 1) species identification, 2) the life history of VELB, 3) the importance of elderberry shrubs as habitat, and 4) all terms and conditions of the USFWS BO for protection, avoidance and minimization of impacts to protected species under ESA.

GIANT GARTER SNAKE

The USFWS BO outlines specific mitigation measures to minimize impact to giant garter snake (GGS). Restrictions regarding GGS in the USFWS BO apply to any land-based operations, which occur on Delta banks other than existing roads or boat ramps, and to mechanical removal of FAV in sensitive GGS habitat. Disturbance of upland GGS habitat will be conducted between May 1 and October 1 to lessen direct effects during the active season, because GGS are actively moving and avoiding danger.

Mechanical harvesters will maintain a speed of 2.0 to 2.5 knots in areas outside of sensitive GGS or areas where GGS has been sighted in the past, making it likely for any present GGS to move out of the area. Additionally, the mechanical harvester will stop and/or reverse the harvester if a snake is seen within FAV during removal. Harvested FAV material, following handpicking or mechanical removal outside of the active season (May 1 – October 1), will be disposed of at an approved spoils area with low to no value GGS habitat to ensure no hibernating GGS are buried under piles of collected FAV.

The entire FAV project area has been evaluated for GGS habitat. This evaluation has been incorporated into the Geographic Information System (GIS) technology utilized by application crews. The application crews were also provided with a set of maps of previously surveyed and sensitive areas for GGS to minimize impact where GGS are most likely to be found.

The USFWS BO requires that personnel involved with the FAV Control Program receive USFWS approved worker environmental awareness training. Under this training program, personnel are informed about the presence of GGS and habitat associated with the species. Training includes: 1) species identification, 2) the life history of the GGS, 3) the importance of irrigation canals, marshes/wetlands, and seasonally flooded areas as habitat, and 4) all terms and conditions of the USFWS BO for protection, avoidance and minimization of impacts to protected species under ESA.

3.1.4 NMFS Letter of Concurrence for FAV

NMFS issued Letters of Concurrence in response to USDA-ARS and DBW's request for ESA Section 7 consultation. Based on the FAV project descriptions and supplemental material provided, and the best available scientific data, NMFS concurs with USDA-ARS and DBW's determination that the proposed use of herbicide products, adjuvants, physical removal, or mechanical methods is not likely to adversely affect federally listed Sacramento River winter-run Chinook salmon (*Oncorhynchus tschawytscha*), Central Valley spring-run Chinook salmon (*O. tschawytscha*), Central Valley steelhead trout (*O. mykiss*), or the Southern distinct population segment (DPS) of North American green sturgeon (*Acipenser medirostris*) or any of their designated critical habitats.

The FAV project description outlines specific mitigation measures and avoidance guidelines to minimize impact to Sacramento River winter-run Chinook salmon, Central Valley spring-

run Chinook salmon, Central Valley steelhead trout, and green sturgeon. Dependent upon the type of water-year and in-stream flows, juvenile Chinook salmon and steelhead may be present in the Delta through June. DBW proposed to begin herbicide applications as early as March 1 in sites where listed fish species are not likely to be present. The remainder of the action area may be treated provided that the available fish monitoring data indicates that salmonids are not likely present or that the pulse of juvenile Chinook salmon has migrated through the Delta. To minimize potential negative effects to chinook salmon and steelhead, DBW and USDA-ARS included specific timing for 2,4-D applications as a part of the proposed project. The proposed time frame for 2,4-D applications is consistent with the 2011 NMFS BO for EPA registration of 2,4-D (for Pacific Salmonids). This BO limits 2,4-D applications from June 15 through September 15 within the legal Delta and from July 15 through August 15 in the San Joaquin River (southern sites).

Specific guidelines were proposed by DBW and USDA-ARS, and thus concurred upon by NMFS to ensure fish are not impacted by FAV applications. The following practices are incorporated into the FAV protocols to avoid oxygen depletion due to decaying vegetation and ensure fish passage: in slow-moving and back-end sloughs infested with invasive floating aquatic vegetation, applicators may only treat up to 3 percent of the mat at one time. In Delta tidal waters, applicators may only treat up to 50 percent of the mat at one time. Mats will be treated up to 3-acre strips, leaving at least 100-foot buffer strips between treated areas. Applicators must maintain buffer zones, treat at specific dissolved oxygen levels, and never block escape routes. Each FAV crew received a copy of the protocol and refresher training on Fish Passage Protocol prior to the 2017 treatment season.

DBW continues to require herbicide applicators to be informed about the presence of Chinook salmon, steelhead, and green sturgeon and their associated habitat. Training includes: 1) species identification, 2) salmonid and sturgeon life history, 3) importance of migratory routes and identification of associated habitat, 4) impact avoidance guidelines and 5) the terms and conditions of the NMFS concurrence letter.

4 PERSONNEL, MATERIALS AND METHODS

4.1 Personnel

4.1.1 Application Crews

During 2018, the FAV Control Program had five to ten full-time crews, each crew consisting of an aquatic pest control specialist and an aquatic pest control technician. Crew availability depended on whether there were concurrent treatments for the SAV Control Program. DBW also had an interagency contract with the California Conservation Corps for additional personnel to assist the application crews. Each crew contains a minimum of one member possessing a Category F (Aquatics) Qualified Applicators Certificate (QAC), administered by the CDPR. Under contract with DBW, Merced County and Fresno County Departments of Agriculture also had staff assigned to conduct surveys, and herbicide treatments or manual removal for FAV in the southern tributaries as needed.

APPLICATION PERSONNEL EDUCATION AND TRAINING

Qualified Applicator Certificate

Application crews receive continuing education credits in pesticide training to keep their QACs current. Continuing education covers pesticide laws and regulations, which may include topics such as federal and state pesticide regulations, pesticide and worker safety, surface and ground water protection, pesticide labeling and label interpretation, and pesticide effects on the environment. Category F QACs are renewed every two years upon completion of the continued education credit requirements.

Environmental Awareness Training

Environmental awareness training for the 2018 season was conducted on Feb. 28, 2018. This training included the following items:

- Identification of commonly observed invasive aquatic plants in the Delta
- Species identification and impact avoidance guidelines on all threatened and endangered species associated with the FAV Program.
- Identification and protection of elderberry shrubs and protocol for monitoring species during an application season.
- Identification and protection of the giant garter snake including life history, importance of irrigation canals, marshes, wetlands, and seasonally flooded areas as habitat.
- Identification and protection of Delta smelt, longfin smelt (*Spirinchus thaleichthys*), Chinook salmon, steelhead, green sturgeon, and associated protected habitats, fishery closure dates, and other regulatory agency requirements.
- Terms and conditions of the USFWS BOs and NMFS letters of concurrence for the FAV Program for protection, avoidance and minimization of adverse effects to protected species under the ESA.
- Avoidance and minimization measures for species of concern that are outlined in the Routine Maintenance Agreement for mechanical removal/harvesting of floating aquatic vegetation.
- Protocol for “take,” including reviewing the “Incidental Take Statement,” collection and handling of dead species, completion of chains of custody, and notification to USFWS.

Equipment Training

Refresher training on the use and calibration of the dissolved oxygen meters and use of Motion F5t Tablet PC and ArcPad application took place in February and March 2018.

4.1.2 Monitoring Personnel

Environmental monitoring activities are overseen by a senior environmental scientist and conducted by qualified personnel, which may include a senior environmental scientist, environmental scientist, and/or student assistants. All water sampling events are carried out in accordance with the Quality Assurance Project Plan (QAPP) and the FAV Environmental Monitoring Protocol as approved by the SWRCB, NMFS, and USFWS.

Environmental scientists are responsible for understanding and adhering to the terms and conditions of applicable regulatory permits and BO. They are also responsible for training other monitoring crew members on monitoring protocols, biological surveys, water sampling techniques, and the calibration and use of field equipment necessary to collect accurate data. Environmental scientists conducted monitoring training for all monitoring personnel during 2018 on environmental monitoring and field equipment protocols.

4.2 Materials and Methods

4.2.1 Herbicide Application

FAV OPERATIONS MANAGEMENT PLAN

The FAV Operations Management Plan (OMP) details general requirements, the scope of program activities, a pre-application planning protocol, application/monitoring coordination protocol, herbicide application protocol; BMPs for herbicide handling, spray equipment maintenance and calibration, spill avoidance and contingency plan, listed species avoidance and habitat evaluation; and dissolved oxygen/temperature measurement, fish passage protocol, and agricultural and water intake coordination.

HERBICIDES AND ADJUVANTS

The herbicides and adjuvants used in 2018 by the FAV Control Program include the following:

Herbicides

- Glyphosate (Monsanto Round-up Custom™), EPA Reg. No. 524-343-ZG
- 2,4-D (Weedar 64 Broadleaf Herbicide), EPA Reg. No. 71368-1-ZB
- Imazamox (Clearcast Herbicide), EPA Reg. No. 241-437-AA-67690

Adjuvant

- Helena Agridex® (paraffin base petroleum oil and polyoxyethylate polyol fatty acid esters), CA Reg. No. 5905-50017-AA
- Wilbur-Ellis Competitor (modified vegetable oil with a non-ionic emulsifier system), CA Reg. No. 2935-50173-AA

DBW acquired restricted materials permits from the county agricultural commissioners for utilizing 2,4-D within the authorized time frame from June 15 to September 15. Sites 203, 205, 207, 213a, 213b, 215, 221, 222, 223, 224, 225, 233 and 238 were included as FAV treatment sites with a March 1 start date as part of the Extensions on the BO. Table 2 shows the FAV treatment sites, the herbicides and the timing of herbicide application per the permits.

Table 2. FAV Treatment Sites, Herbicides and Timing

Delta smelt (DS) Habitat Level	USFWS Area	Delta Boundary Area	Treatment Site Numbers	Fish Survey Reporting Required[b,c]	Glyphosate	2,4-D[d]	Penoxsulam[e]	Imazamox[e]	Agridex	Competitor
Primary DS Habitat	1	Legal Delta North of Hwy 12	200- 290	June 1 to June 30	June 1 to Nov. 30	No	No	No	June 1 to Nov. 30	No
		Legal Delta South of Hwy 12	16-24b, 39-44, 69, 98a-176	June 1 to June 30	June 1 to Nov. 30	June 15 to Sept. 15	No	No	June 1 to Nov. 30	No
Secondary DS Habitat	2	Legal Delta South of Hwy 12	11-15, 33, 49-68, 78, 79, 83a-97	March 1 to June 30	Mar. 1 to Nov. 30	June 15 to Sept. 15	No	No	Mar. 1 to Nov. 30	No
Tertiary DS Habitat	3	Legal Delta South of Hwy 12	1-10, 25-38, 45-48, 70-77, 80-82, 291	March 1 to June 30	Mar. 1 to Nov. 30	June 15 to Sept. 15	Mar. 1 to Nov. 30	Mar. 1 to Nov. 30	Mar. 1 to Nov. 30	Mar. 1 to Nov. 30
Non-DS Habitat	4	Legal Delta South of Hwy 12	300-309	March 1 to June 30	Mar. 1 to Nov. 30	June 15 to Sept. 15	Mar. 1 to Nov. 30	Mar. 1 to Nov. 30	Mar. 1 to Nov. 30	Mar. 1 to Nov. 30
		Non-Legal Delta	310 and above	March 1 to June 30	Mar. 1 to Nov. 30	July 15 to Aug. 15	Mar. 1 to Nov. 30	Mar. 1 to Nov. 30	Mar. 1 to Nov. 30	Mar. 1 to Nov. 30

[a] DBW may not treat in any site if DO is between 3 ppm and Basin Plan limits (5 ppm to 8 ppm, by location). DBW may not treat if winds are >10 mph (or >7 mph in Contra Costa County).

[b] DBW will implement a survey-based approach to conducting treatments that allows for treatments from March through June in areas with re-growing water hyacinth when listed fish species are not present, as reported to NMFS and USFWS.

[c] DBW environmental scientists will continue to monitor fish surveys and avoid treating in sites where listed fish species are present; however, formal weekly reporting to NMFS and USFWS is not required after July 1.

[d] The 2,4-D time and location restrictions are specified in the NMFS BO for the Environmental Protection Agency registration of pesticides in order to protect listed salmonid species.

BEST MANAGEMENT PRACTICES

DBW developed a series of BMPs that outline methods or techniques that have been found to be the most effective and a practical means of achieving a particular objective and/or to comply with FAV Program requirements:

- Herbicide Handling Requirements – All personnel will be trained in herbicide handling in accordance with Food and Agriculture Code and Title 3 Code of Regulations pertaining to Pesticides and Pest Control Operations.
- Spray Equipment Calibration – Herbicide application equipment used for the FAV Program is to be calibrated on at least a monthly basis during the treatment season.
- Spill Avoidance and Contingency Plan – All herbicide spills are treated as emergencies and need to be remediated immediately. DBW applies preventative measures to reduce the potential for a serious spill.
- Annual Environmental Awareness Training – All personnel involved in the FAV control program received required Annual Environmental Awareness training.
- Endangered Species Avoidance Measures – Implement avoidance measures to reduce or eliminate potential impacts of the programs on endangered species.
- Agricultural and Water Intake Coordination – Specific measures are implemented to ensure herbicide treatments do not negatively impact water intakes. All herbicide label requirements are followed as they related to use of treated water for irrigation or drinking

purposes. DBW also coordinates with county, water districts, State Water Project (SWP) or Central Valley Project (CVP) regarding water quality impacts.

APPLICATION EQUIPMENT

Herbicide applications in 2018 were conducted with hand held spray wands operated from 16 to 21-foot airboats, outboard aluminum boats, or a ground spray rig. The boats are equipped for direct metering of herbicide, adjuvant, and water into the pump system of the spraying unit. Each application crew utilized a Hach® HQ-30 Dissolved Oxygen Meter and a Motion F5t Tablet PC to record pre-spray and post-spray temperature, dissolved oxygen, wind speed, beginning and ending Universal Transverse Mercator (UTM) coordinates of spray area, amount of herbicide used, and the date and time of treatment.

Spray equipment were calibrated when possible, generally on at least a weekly basis, after changing injection pumps, or whenever problems with the equipment occurred. Injection systems were cleaned daily and hoses were cleaned as needed. Pump oil was changed every 50 hours. Boat maintenance was also conducted on a regular basis.

SITE SELECTION AND PRIORITIZATION

Prior to the start of the 2018 treatment season, field crews visually surveyed all sites in their application region and estimated the amount of acres infested with FAV. Herbicide applications were prioritized such that nursery areas with high amount of growth and areas that are critical to public, agricultural, municipal, industrial, recreational, or navigational use were treated first. DBW prioritized treatment sites based on results of pre-season field surveys, combined with the staff's experience and knowledge of FAV growth patterns and distribution. Each site was ranked on several factors including: (1) whether or not the site was a nursery area, (2) current infestation levels, (3) potential for infestation, and (4) whether the site is important for navigation, public safety, recreation, and/or commercial use. Initial plans indicated the general priority for site treatment, and treatment plans were modified during the season due to weather conditions, growth and movement of FAV, and environmental considerations. Logistics, such as number of application crews available, travel time to sites, herbicide label restrictions, environmental mitigations measures, and daily tidal conditions, are also factored into daily site selections for treatment.

Following the terms and conditions specified in the NPDES permit, BOs, and concurrence letters, a number of sites were available for treatment starting in March, with the remainder of sites open for treatment after June 1. During the March to June time period when delta smelt, winter-run Chinook, spring-run Chinook, and/or steelhead juveniles were entering and/or present in the Delta, site selection depended on available Interagency Ecological Program (IEP) monitoring data showing the absence of special status fish species in treatment sites. Between March 1 and June 30, weekly fish survey and planned treatment site summaries were shared with the public through weekly email notifications regarding the program.

The 2018 herbicide application season began on March 12, 2018 in sites within USFWS Areas 2, 3 and 4, where protected fish species were not likely to be present. Throughout the season, fish monitoring data was continuously reviewed to avoid treating in sites where listed fish species were likely to be present. Sites selected for treatment were based on levels of FAV infestation, level of impacts to navigation, public safety, recreation and/or commercial use, threats to agricultural water pumping facilities. During 2018, the site selection process also

considered information and concerns regarding FAV received via email and phone from the public.

4.2.2 Environmental Monitoring

FAV NPDES Annual Monitoring Protocol

All water quality monitoring follows the NPDES Annual Monitoring Protocol as outlined in the APAP, which was approved in January 2014 by the SWRCB. Quality control and quality analysis measures are outlined in the QAPP. Monitoring activities include recording FAV impacts on beneficial waters of the U.S., federally listed threatened and endangered species, and their habitats. DBW is required to document herbicide residues in receiving waters and monitor water quality parameters such as dissolved oxygen, temperature, conductivity, pH, turbidity, and waterway appearance at representative monitoring locations.

Monitoring Equipment

A 19- to -21-foot aluminum air boat or a 22-foot outboard motorboat was used for monitoring activities. Water samples were collected at a depth of 3 feet using the MasterFlex® E/S® Portable Sampler fitted with 7 to 10 feet of tubing. Water samples were stored on ice in 1000 mL amber glass bottles. Water quality parameters were measured with a Hydrolab® Model MS5 mini datasonde. Water quality parameters included water temperature, electrical conductivity, salinity, dissolved oxygen, pH, and turbidity. Parameters measured by the Hydrolab® were geographically referenced with GPS coordinates with a Motion F5t Tablet PC and ArcPad application. Data were captured electronically using Hydroplus® software specifically modified for the FAV Control Program. In the event of datasonde malfunction, a Hach® HQ-30 Dissolved Oxygen Meter was used as a backup to measure temperature and dissolved oxygen within monitoring sites. In addition, all data was hand written on datasheets as a backup copy. These datasheets were subsequently used for data quality control purposes. A digital camera was used to provide visual records of sampling locations and other notable factors that may affect water quality, species of concern, or the condition of the surrounding environment. Several monitoring sites were marked with flagging tape for quick identification for follow-up visits.

To avoid water sample contamination, boats used for environmental monitoring were never used for herbicide applications. Monitoring boats were also periodically washed. To ensure that water quality data is reliable, Hydrolabs® and Hach® DO meters were calibrated on a regular basis based on the manufacturer's requirements.

Monitoring Site Selection

Environmental monitoring sites were selected based on requirements listed under the NPDES permit and BOs. The SWRCB Statewide General NPDES Permit requires that dischargers monitor a certain proportion of sites based on the total number of treated sites. DBW currently monitors a minimum of one application events for each active ingredient in each environmental setting (flowing water and non-flowing water) per year. Since DBW does not conduct herbicide applications in non-flowing water, and tidal and riverine water body types are considered flowing water, all monitoring took place only in the "flowing water" environmental setting category. In 2018, a total of sites within the Delta were designated as monitoring sites (Table 3). Locations of the sites monitored in 2018 are mapped in Appendix A, Figure A-1.

Representative monitoring occurred in sites with varying degrees of habitat for the following species (Table 4): giant garter snake, delta smelt, and valley elderberry longhorn beetle. Giant garter snake habitat has been rated as low, medium or high, while VELB and delta smelt habitat are classified as being absent or present based on the known distribution of delta smelt and the known locations of elderberry shrubs in the project area.

RESIDUE SAMPLING

Water sampling occurs on the same day of the respective herbicide application, in addition to follow-up sampling at the same locations within a week after treatment. All sampling stations at representative locations are identified as “A”, “B”, and “C”. Sampling station “A” represents the treatment area where FAV species were treated. Sampling station “B” represents receiving water that is downstream from the treatment area. Sampling station “C” represents a control site that is sampled before herbicide treatment, typically upstream of the treatment area. Sampling times are identified as “1”, “2”, and “3”. Sampling time “1” indicates pre-treatment. Sampling time “2” indicates immediately post-treatment. Sampling time “3” indicates within seven days after treatment. Thus, sample 1A is taken before a treatment, within the treatment area. Likewise, sample 3C is taken within one week after treatment, upstream of the treatment area (i.e. control site). All water quality monitoring followed the NDPES Annual Monitoring Protocol as outlined in the APAP.

Table 3. 2018 FAV Monitoring Sites

Site #	Location	Water Body Type	Herbicide
58	Middle River	Tidal	2,4-D
15	Little Venice/Little Connection	Tidal	Imazamox
122	Donlon Island	Tidal	Glyphosate
124	Sherman Lake	Tidal	Glyphosate

Table 4. 2018 FAV Monitoring Sites and Habitat Quality

Site #	Location	GGS Habitat Quality	Smelt Habitat	VELB Habitat
58	Middle River	Low to Low-Moderate	Absent	Absent
15	Little Venice/Little Connection	Moderate to Moderate-High	Absent	Present
122	Donlon Island	No habitat value to high	Present	Absent
124	Sherman Lake	Moderate to Moderate-high	Present	Absent

4.2.3 Contract Laboratory Standard Operating Procedures

The analytical methods used by contract laboratories are published in the EPA Test Methods for Evaluating Solid Waste Physical/Chemical SW 846 or EPA Method for Chemical Analysis of Water and Waste. Analysis of water samples was conducted by Dr. Pramod Pandey’s laboratory at the Department of Population and Health, School of Veterinary Medicine at UC Davis. The method used to analyze both 2,4-D in surface water was high performance liquid chromatography. The methods used to analyze Glyphosate in surface water were both High

Performance Liquid Chromatography (HPLC) and an Enzyme-Linked Immunoassay. The method used to analyze imazamox in surface water was HPLC.

ANALYTICAL TESTING VALIDATION

DBW used several methods to validate results found by contracting laboratories. These methods included collecting split (duplicate) water samples, field blanks, and equipment blanks. An equipment blank sample (de-ionized water collected using the sampling device) was collected at every sampling event to detect potential contamination from sampling equipment.

4.2.4 Point Intercept Sampling

Point-sampling surveys for FAV were implemented into the control program in an effort to further determine change in species composition of FAV over time. Point sample data was acquired using a pole with graduated lines placed on the water surface at 30 randomly selected points within selected sites.

The data was collected during the summer; however, one more year of data is needed to do further analysis.

4.2.5 Photo Point Monitoring

Photo point monitoring for FAV was implemented into the control program in an effort to monitor FAV and ecosystem change over a period of time. This process consists of taking repeated pictures with the same field of view of the same location (site) at multiple pre-selected locations (sites).

Pictures were taken at various sites by land and by water pre-treatment and post-treatment season. Pictures can be accessed in Appendix A, Figures A-11 and A-12.

5 MONITORING RESULTS AND DISCUSSION

5.1 Threatened and Endangered Species

The USFWS has established incidental take for ESA listed species and outlined terms and conditions necessary to minimize the impact of incidental take on threatened and endangered species. No incidental take of threatened or endangered species occurred in the 2018 season. Since NMFS concurs with USDA-ARS and DBW's determination that the proposed FAV Control Program is not likely to adversely affect federally listed salmonids or green sturgeon, or their habitat, there is no incidental take provided by NMFS in implementing the FAV Control Program.

5.2 Infestation and Herbicide Application

In 2018, the FAV Control Program conducted a total of 688 herbicide applications within 190 sites of the project area (Figures A-4 to Figure A-9 in Appendix A, and Appendix C). The treated sites encompassed more than half of the Delta, in addition to the San Joaquin River, Tuolumne River, Merced River and Salt Slough. There were several locations in the Delta and tributaries that were identified to having high FAV infestations and were considered high priority areas. These sites included Stockton area waterways (Fourteen Mile Slough, the Deep Water Ship Channel, White Slough), reaches of Old River and Middle River in the South Delta, Latham Slough, and Empire Tract Slough. Herbicide treatments were moderately to highly effective in controlling FAV. Observations of herbicide symptoms, such as wilting, yellowing and browning, were observed from all treatments.

Based on surveys conducted by DBW staff, FAV was better controlled in 2018 as there were observed decreases in the amount of FAV biomass present in Delta waterways, primarily water hyacinth. Starting FAV herbicide treatments early in the season, increased staffing by DBW, better inter-agency coordination (local, state and federal) and natural influences of temperatures and increased flow from rains are all possible factors as to why overall FAV conditions improved in 2018.

5.2.1 Summary of Herbicide Use

Each crew completed a daily treatment log to record herbicide treatment activities. The 2018 FAV daily log information can be found in Appendix B, Tables B-1 to B-9. Herbicide applications were made only when DO levels were either above the Basin Plan limit, adopted by the CVRWQCB, or below 3.0 mg/L. No applications were made if DO concentrations were between 3.0 mg/L and the Basin Plan limits (5 mg/L to 8 mg/L, depending by location).

The herbicide treatment season began on March 12, 2018 and continued to Nov. 30, 2018. Herbicide applications utilized glyphosate, Imazamox, 2,4-D, with the adjuvants Agridex and Competitor. To minimize potential negative effects to salmon and steelhead, DBW and USDA-ARS included specific timing for 2,4-D applications as a part of the proposed project. The proposed time frame for 2,4-D applications is consistent with the 2011 NMFS BO for EPA registration of 2,4-D (for Pacific Salmonids), which limits 2,4-D applications from June 15 through September 15 within the legal Delta, and from July 15 through August 15 in the San Joaquin River (southern sites).

The time to symptom development in FAV treated with glyphosate ranged from 1 to 3 weeks. Visible effects were gradual wilting and yellowing of the plants which eventually advanced to

complete browning. For FAV treated with 2,4-D, the time to symptom development was faster, with wilting and chlorosis of the plants being observed as early as two days after treatment. Observations of herbicide symptoms such as wilting, yellowing and browning were observed from all treatments. However, as temperatures decreased during the fall months, herbicide symptoms were slower to appear due to decreased plant growth rates, which caused a decrease in herbicide uptake and translocation rates. In some cases, treated plants remained floating for a significant amount of time, but most decomposing plants eventually sank in to the water column.

In 2018, the DBW applied 2,528 gallons of glyphosate, 960 gallons of 2,4-D, 242 gallons of Imazamox, 1,582 gallons of Agridex, and 127 gallons of Competitor for FAV control. Herbicide treatments of the 2018 season began on March 12, 2018 and continued through Nov. 30, 2018. DBW successfully treated a total of approximately 2,557 acres of water hyacinth, spongeplant, water primrose, and/or alligatorweed in the Delta and its tributaries (Table 5, Figures 1–3, and Appendix A, Figures A-8 and A-9).

The total acreage of FAV each year between 1990 and 2018 (Figure 4) varies since the number of acres treated in a given year can reflect the magnitude of infestation; however, other factors can also affect the amount of treatment that occurs (treatment start dates, regulatory restrictions, local water conditions, weather, staff levels, etc.). Water hyacinth was not treated in 2000 as the control program was not implemented in response to legal action from Delta Keepers, where they claimed that DBW should obtain an NPDES permit under the *9th Circuit Court's Headwaters Inc. v. Talent Irrigation District* decision (2001). Other noteworthy events include the additions of South American spongeplant in 2013 and Uruguay water primrose in 2016 to the FAV Control Program.

Table 5. 2018 FAV Herbicide Use and Acreage Treated by Month

Month	2,4-D		Glyphosate		Imazamox		Penoxsulam		Agridex	Competitor
	gallons	acres	gallons	acres	gallons	acres	ounces	acres	gallons	gallons
MARCH	0	0	0	0	0	0	0	0	0	0
APRIL	0	0	33.76	35.40	3.75	3.69	0	0	13.46	4.50
MAY	0	0	74.92	76.74	9.50	10.61	0	0	36.02	4.50
JUNE	140.50	134.25	106.08	77.19	25.50	19.86	0	0	53.25	14.75
JULY	1151.71	68.41	407.60	245.12	32.00	23.17	0	0	263.39	16.50
AUGUST	452.00	190.88	402.88	277.70	30.00	28.11	0	0	402.74	21.00
SEPTEMBER	215.75	144.38	432.75	420.00	2.00	1.97	0	0	294.25	1.00
OCTOBER	0	0	786.27	533.72	112.00	86.17	0	0	386.76	54.00
NOVEMBER	0	0	284.00	165.95	27.25	13.72	0	0	135.75	11.25
Total	959.96	537.92	2528.26	1831.83	242.00	187.31	0	0	1585.62	127.50

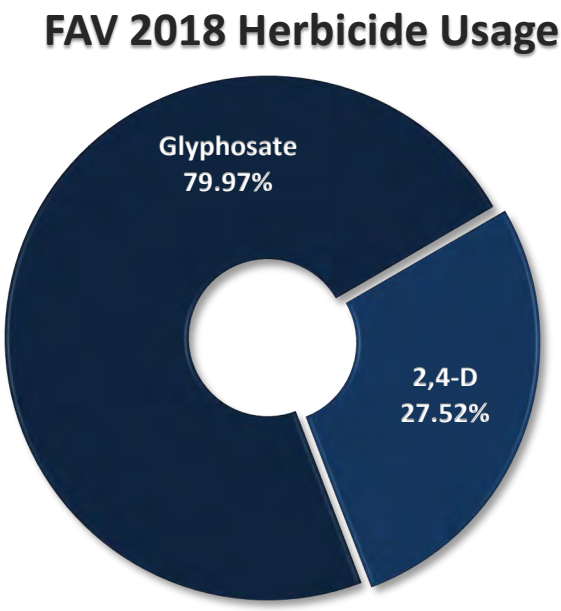


Figure 1. 2018 FAV Herbicide Use

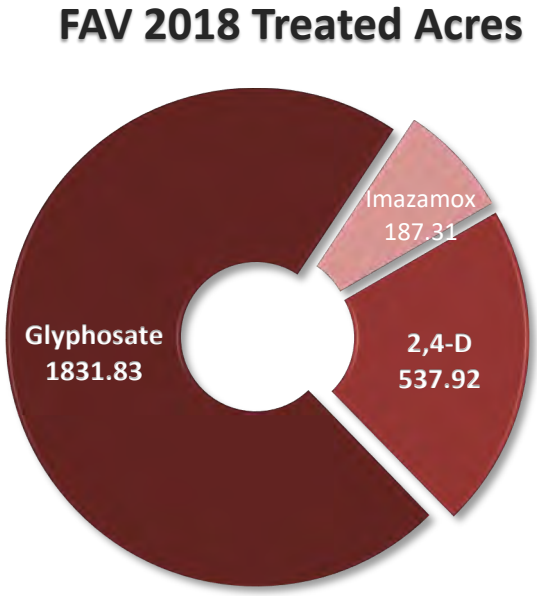


Figure 2. 2018 FAV Acreage Treated Per Herbicide

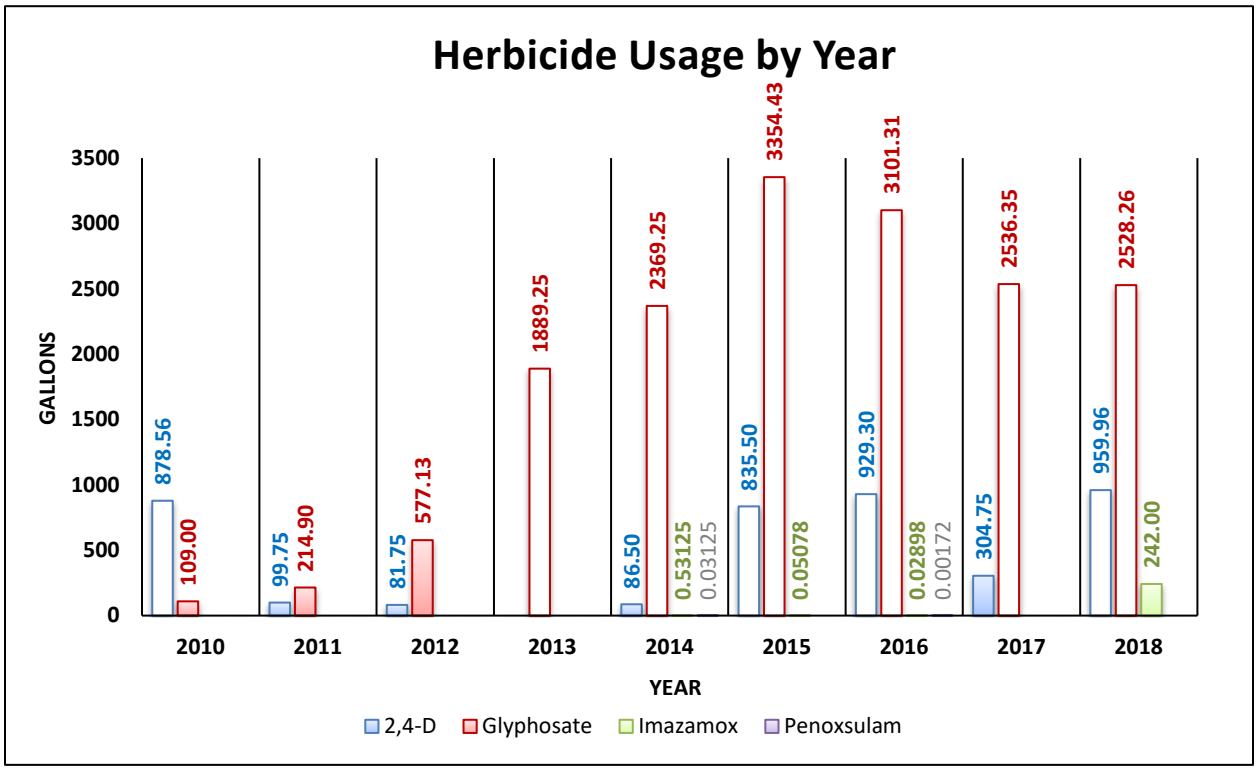


Figure 3. Herbicide Use by Year 2010 to 2018

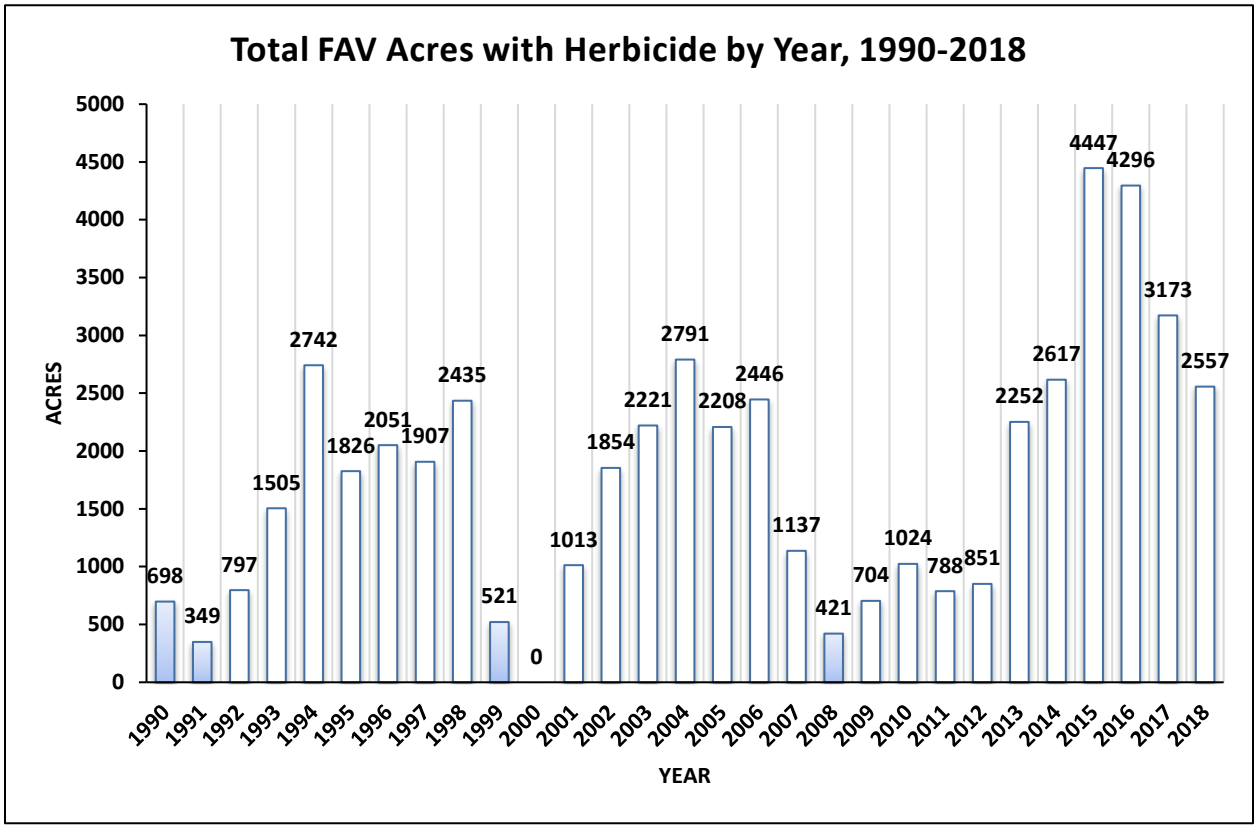


Figure 4.Total FAV Acres Treated with Herbicide by Year, 1990-2018

5.3 Monitoring Data and Laboratory Results

In 2018, a total of four (4) sites within the legal Delta were selected as monitoring sites (Table 3 and Figure A-1, Appendix A). For site selection criteria please refer to "Monitoring Site Selection" under Section 4.2.2. Field monitoring data and lab results collected in compliance with the NPDES permit and BOs are summarized in Appendix D. Figures and tables found within Appendix D document the sample locations, herbicide residues, and water quality data for these 4 monitoring sites. Maps of monitoring sites have points and polygons color coded by the type of herbicide used: red = 2,4-D and yellow = glyphosate.

The NPDES permit (General Permit No. CAG990005, Water Quality Order No. 2013-0002-DWQ), that became effective on Dec. 1, 2013, contains sampling requirements that are materially less than what has been historically measured in terms of frequency of measurement. To ensure that the FAV Control Program maintains environmental quality measures and meet federal ESA requirements, and that monitoring provides independent statistical validity, DBW aims to maintain a more thorough monitoring plan as resources will allow.

5.3.1 Dissolved Oxygen, Turbidity, and pH

All readings were within Basin Plan limits.

5.3.2 Herbicide Residue Concentrations

Maximum residue limits are based on EPA municipal drinking water standards. Herbicide residue shall not exceed the following concentrations in receiving waters (Table 6).

Table 6. Receiving Water Limits for FAV Herbicides

Herbicide Active Ingredient	Maximum Concentration
2,4-D	70 ppb
Glyphosate	700 ppb
Imazamox	No receiving water limit
Penoxsulam	No receiving water limit

ppb= Parts per Billion (µg/l)

During 2018, all herbicide residue concentrations at receiving water locations were either not detected or were below receiving water limits as specified in the NPDES permit (Appendix D).

5.3.3 Aquatic Pesticide Application Plan Effectiveness

The APAP describes aquatic pesticides, adjuvants and application methods used for the FAV Control Program. The selected herbicide and adjuvants were effective on water hyacinth, spongeplant, and water primrose as described in Section 5.2 above. Herbicide application methods and BMPs were effective in maintaining herbicide residues in receiving water below the maximum concentration limits. In addition, all reporting requirements described in the APAP, such as providing a Pest Control Recommendation, Notice of Intent (NOI) and public notification, were met. NOIs were provided to County Agricultural Commissioner's at least 24 hours before herbicide applications were made. The NOI included descriptions of treatment

locations and application rates for restricted use materials, such as 2,4-D, in addition to all other herbicides used by the FAV Program. DBW continued to distribute weekly email notifications to stakeholders who subscribed to the distribution list. These weekly notifications provided information on planned treatment areas, facts, and figures on the 2018 treatments (Appendix E).

5.4 Alternative Control Methods and Special Studies

5.4.1 Non-Chemical Control

Handpicking

Manual removal (handpicking) methods are included as part of the FAV integrated pest management approach. While routine surveying and handpicking are generally conducted every year by the Fresno County Department of Agriculture for sites along the San Joaquin River within Fresno County, the increased amount of precipitation and water flow during the 2016-2018 winter reduced FAV activities during the 2018 season. The Fresno County Department of Agriculture surveyed for water hyacinth in Sites 902-906, 909-913, 921, and 929 during the month of June, and found that neither herbicide control nor handpicking was warranted as no water hyacinth was found. No further surveys were conducted after June due to contract terms.

Mechanical Removal

Through consultations with USFWS and NMFS, DBW proposed to utilize a calendar-based schedule for FAV activities from 2013 to 2018, which included the use of mechanical removal of FAV from July to April and except May and June. Mechanical control of FAV was also conducted under a Streambed Alteration Agreement (or Routine Maintenance Agreement) between DBW and CDFW (Notification No. 1600-2015-0132-R3). The agreement became effective Oct. 23, 2015 and is valid through Dec. 31, 2019, and pertains only to the physical and mechanical removal of FAV. The RMA contains avoidance and minimization measures for fish and wildlife species of concern. Examples of these species include giant garter snake, delta smelt, longfin smelt, Swainson's hawk (*Buteo swainsonii*), burrowing owl (*Athene cunicularia*) and western pond turtle (*Emys marmorata*). Before any work can commence, environmental scientists approved by CDFW and USFWS, conduct biological surveys in the project area to make sure that there are no species of concern. In addition to biological surveys, a biological monitor must be on site to assure that no species of concern or their habitats are being or will be significantly affected by the FAV removal operation. Furthermore, DBW provides environmental awareness training to project crews at all sites.

Under a four-year contract with the firm, Aquatic Environments, Inc. and their subcontractors, Clean Lakes, Inc. and Waterworks Industries, Inc., DBW conducted mechanical harvesting of FAV in several locations in the Delta that were identified as being a nursery site or having high infestations of water hyacinth, spongeplant and/or water primrose. Project locations included Fourteenmile Slough, West Side Irrigation District Canal, and Old River and River's End (Table 7 and Figure A-10, Appendix A). Mechanical removal utilized a combination of harvesters, transport barges, excavators, and dump trucks. DBW was able to conduct mechanical harvesting throughout the year (Figure 5). Approximately 15,650 cubic yards or roughly 9.70 acres of FAV were removed by mechanical means in the aforementioned sites between March 19, 2018 and Dec. 27, 2018.

Table 7. 2018 FAV Sites Controlled by Mechanical Harvesting

Site(s)	Location	Harvesting Date(s)	FAV CYs Removed	FAV Acres Removed
28	Fourteenmile Slough	March 19, 2018 – April 17, 2018	3,050	1.89
77	West Side Irrigation District Canal	November 27, 2018 – December 13, 2018	6,825	4.23
78 & 79	Old River & River's End	December 17, 2018 – December 27, 2018	5, 775	3.58

CY = cubic yards

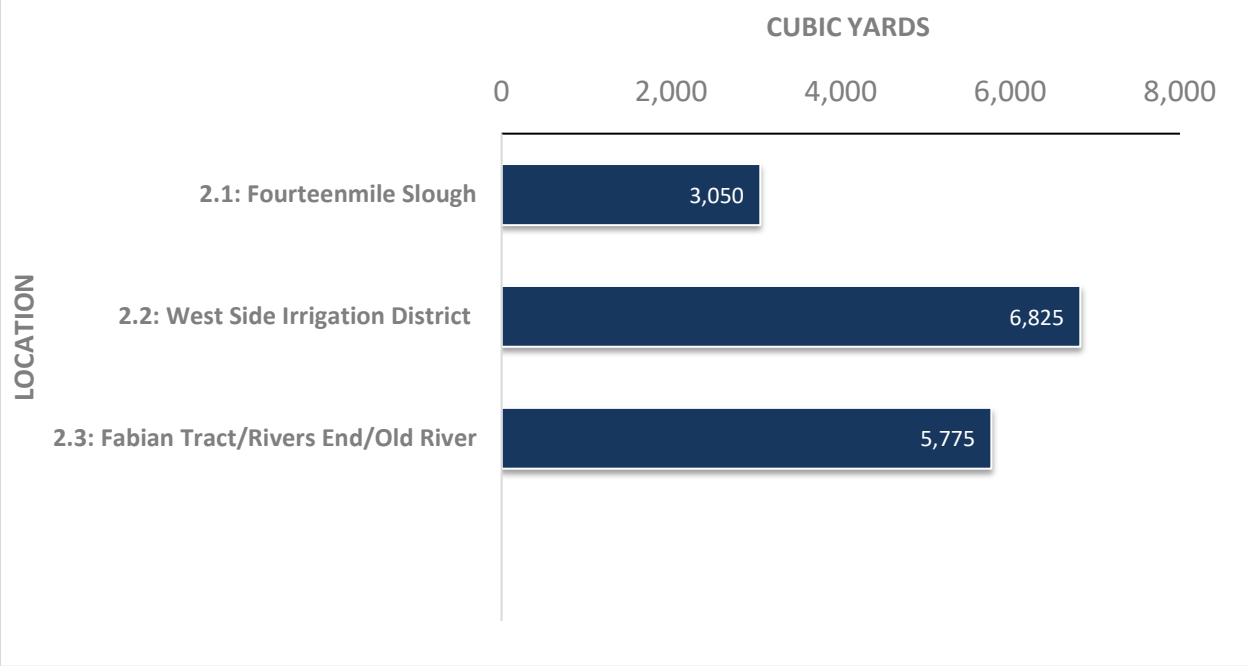


Figure 5. Cubic Yards of FAV Removed by Month

For each harvesting project, the collected FAV was temporarily stockpiled on the water side of the banks or levees before being further removed by an excavator. To prevent possible disturbance to the levee bank and minimize erosion from water runoff from FAV loads, plastic liners, straw wattles, and/or plywood were placed on the bank and levee where the harvester and/or excavator stockpiled water hyacinth. The loads of FAV were also allowed to drain before moving the material onshore. Once excess water was drained, plant material was removed with an excavator and moved to a dump truck, then taken to an approved spoils site. DBW coordinated and collaborated with various land owners/managers to secure right-of-entry for harvesting operations and use of land as a spoils area. These parties included Port of Stockton, West Side Irrigation District and Bureau of Reclamation.

Herding

In past years, DBW crews used boats to herd (push) large mats of water hyacinth out of a site or towards an awaiting excavator or conveyor for removal. This year, DBW crews did not conduct herding of FAV.

5.4.2 Herbicide Drift and Dissipation Study

In preparation for the new consultation process with the USFWS and NMFS beginning in 2017, DBW collaborated with Dr. Lars Anderson, with the University of California, Davis, to evaluate a) the amount of “spray through” of herbicide applications (by boat) in varying densities of water hyacinth canopy cover and b) the dissipation of the active ingredient(s) in the surface water that may receive the “spray through”. Further information regarding the study can be found in the Biological Assessment dated Oct. 13, 2017.

5.4.3 Delta Smelt Resiliency Strategy

The Delta Smelt Resiliency Strategy (DSRS) is a science-based document that has been prepared by the State of California to voluntarily address both immediate and near-term needs of delta smelt. The primary objective of the DSRS is to improve the status of delta smelt by promoting their resiliency to drought conditions and future variations in habitat conditions. The DSRS includes the goal of improving habitat conditions for the delta smelt such as increased spawning and rearing habitat area, improved habitat quality, increased food resources, higher turbidity, and reduced levels of invasive species, both invasive aquatic plants and non-native predators. State agencies that could implement this strategy include DWR, CDFW and DBW. The division considers the strategy when making management decisions in coordination with these entities.

6 ACKNOWLEDGEMENTS

DBW would like to thank the following entities for their cooperation and collaboration on invasive aquatic plant management in the Sacramento-San Joaquin Delta:

California Department of Fish and Wildlife
California Department of Food and Agriculture
California Department of Water Resources
City of Stockton
Contra Costa Water District
County Agricultural Commissioners
County Sheriffs
County Vector Control Districts
Delta Conservancy
Delta Protection Commission
Delta Stewardship Council
National Aeronautics and Space Administration
National Oceanic and Atmospheric Administration – National Marine Fisheries Service
Paradise Point Marina
Port of Stockton
State Water Resources Control Board
Stone Lakes National Wildlife Refuge
Turlock Irrigation District
United States Bureau of Reclamation
United States Department of Agriculture – Agricultural Research Service
United States Fish and Wildlife Service
University of California, Davis
West Side Irrigation District

A special thanks to:

Various Chambers of Commerce
Stakeholders and Members of the Public
Numerous Legislative Offices

7 LITERATURE CITED

California Department of Parks and Recreation Division of Boating and Waterways. 2012. Water Hyacinth Control Program Biological Assessment. California Department of Parks and Recreation, Division of Boating and Waterways, Sacramento, CA.

California Department of Parks and Recreation Division of Boating and Waterways. 2014. Spongeplant Control Program Biological Assessment. California Department of Parks and Recreation, Division of Boating and Waterways, Sacramento, CA.

California Regional Water Quality Control Board. 1998. Fourth Edition of the Water Quality Control Plan (Basin Plan) for the Sacramento River and San Joaquin River Basins. California Regional Water Quality Control Board, Central Valley Region, Sacramento, CA.

Headwaters Inc. v. Talent Irrigation District. 243 F. 3d 526. U.S. Court of Appeals, 9th Circuit. 2001.

APPENDIX A

FAV Control Program Maps and Photos

All maps by M.Kwong, J. Martinez, C. Dominguez, and L. Escobar

Figure A-1. 2018 FAV Project Area and Monitoring Sites in the Legal Delta

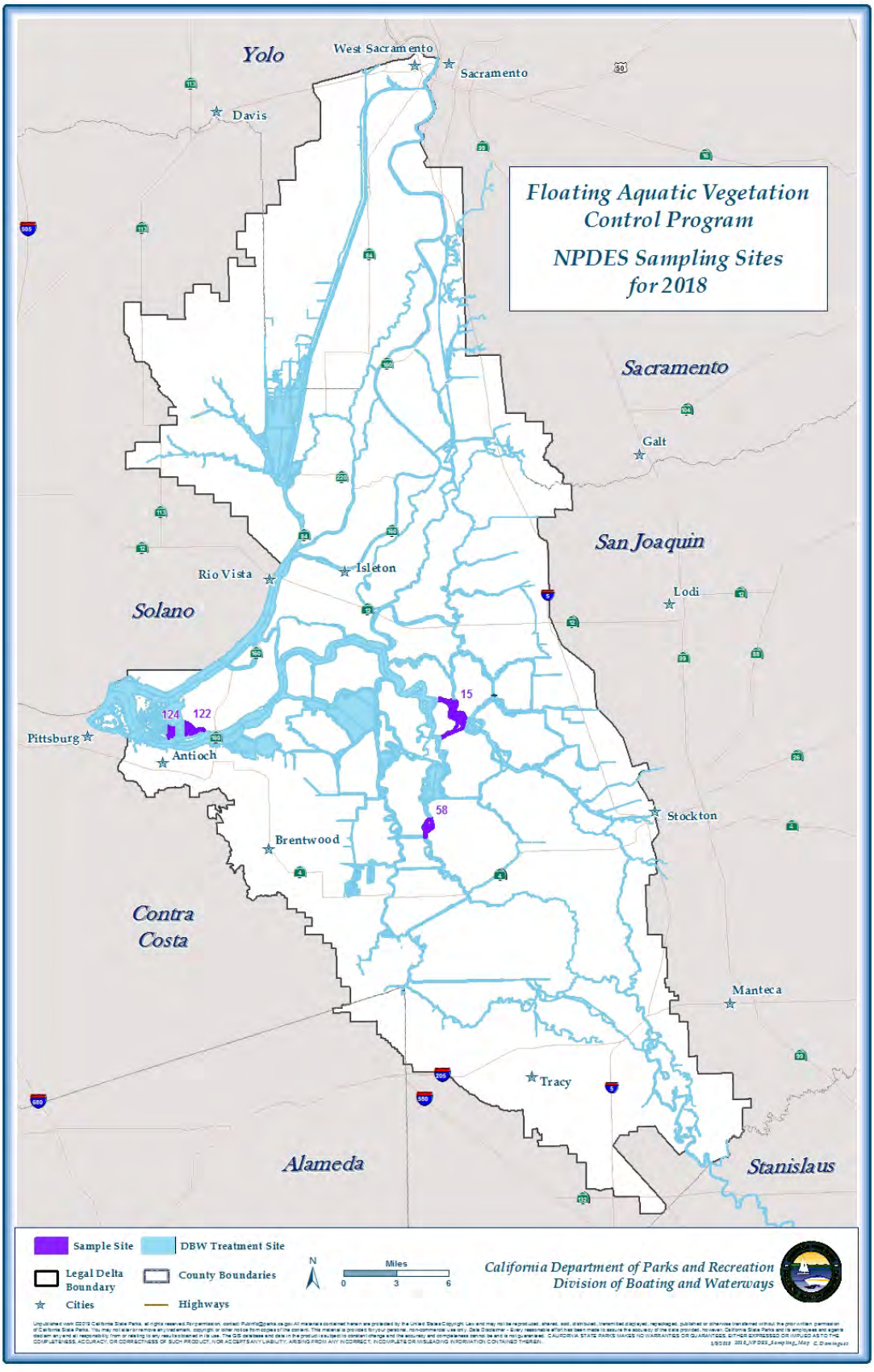
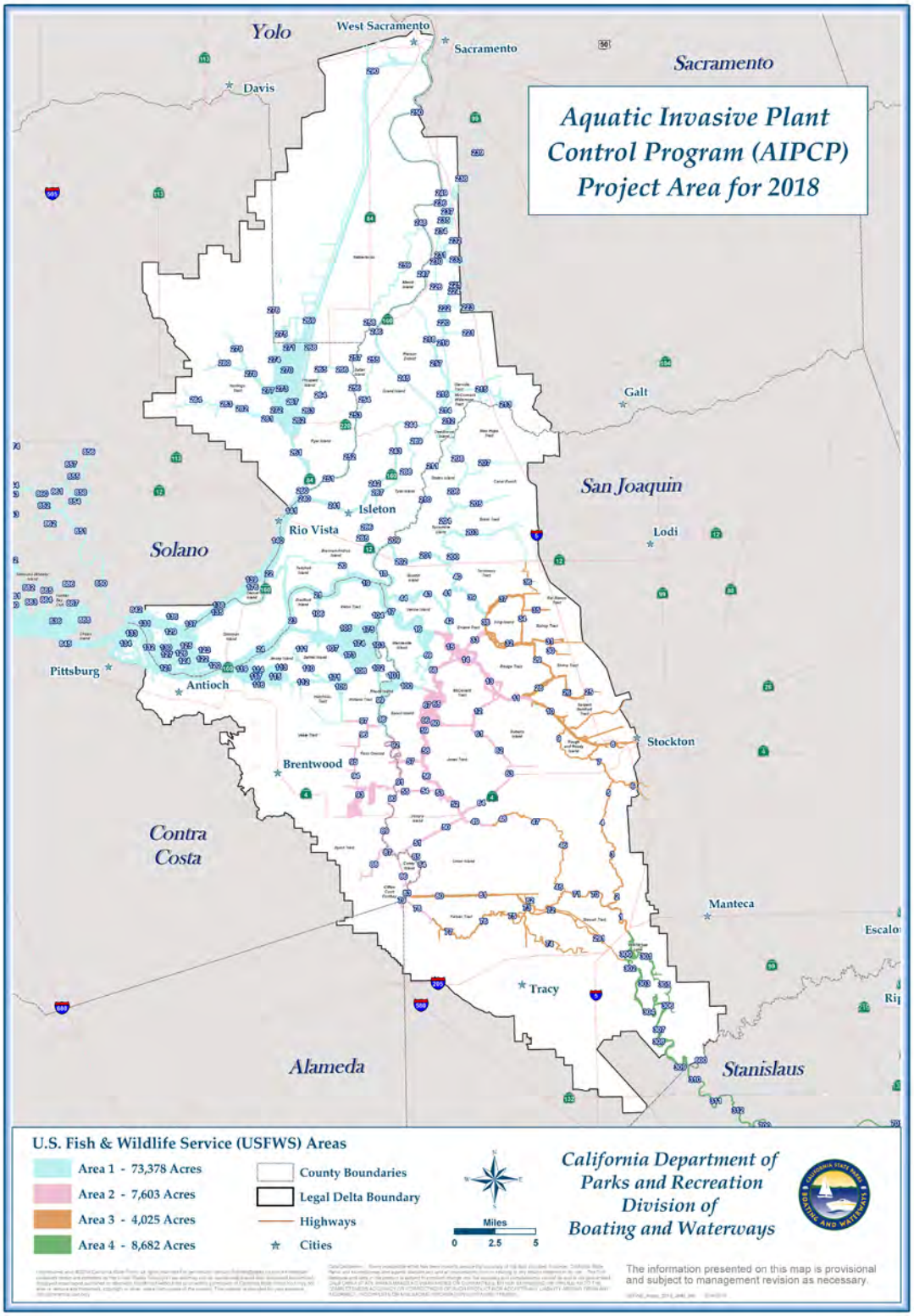

Floating Aquatic Vegetation Control Program
NPDES Sampling Sites for 2018
Yolo
West Sacramento
Sacramento
Davis
Sacramento
Galt
San Joaquin
Rio Vista
Isleton
Lodi
Solano
124
122
15
Pittsburg
Antioch
58
Stockton
Brentwood
Contra Costa
Manteca
Tracy
Alameda
Stanislaus
Sample Site
DBW Treatment Site
Legal Delta Boundary
County Boundaries
Cities
Highways
N
Miles
0 3 6
California Department of Parks and Recreation
Division of Boating and Waterways

Figure A-2. FAV Northern Sites and USFWS Areas


Aquatic Invasive Plant Control Program (AIPCP) Project Area for 2018
Yolo
West Sacramento
Sacramento
Sacramento
Davis
Galt
San Joaquin
Isleton
Rio Vista
Lodi
Solano
Pittsburg
Antioch
Stockton
Brentwood
Contra Costa
Manteca
Tracy
Alameda
Stanislaus
U.S. Fish & Wildlife Service (USFWS) Areas
Area 1 - 73,378 Acres
Area 2 - 7,603 Acres
Area 3 - 4,025 Acres
Area 4 - 8,682 Acres
County Boundaries
Legal Delta Boundary
Highways
Cities
Miles
0 2.5 5
California Department of Parks and Recreation Division of Boating and Waterways
The information presented on this map is provisional and subject to management revision as necessary.

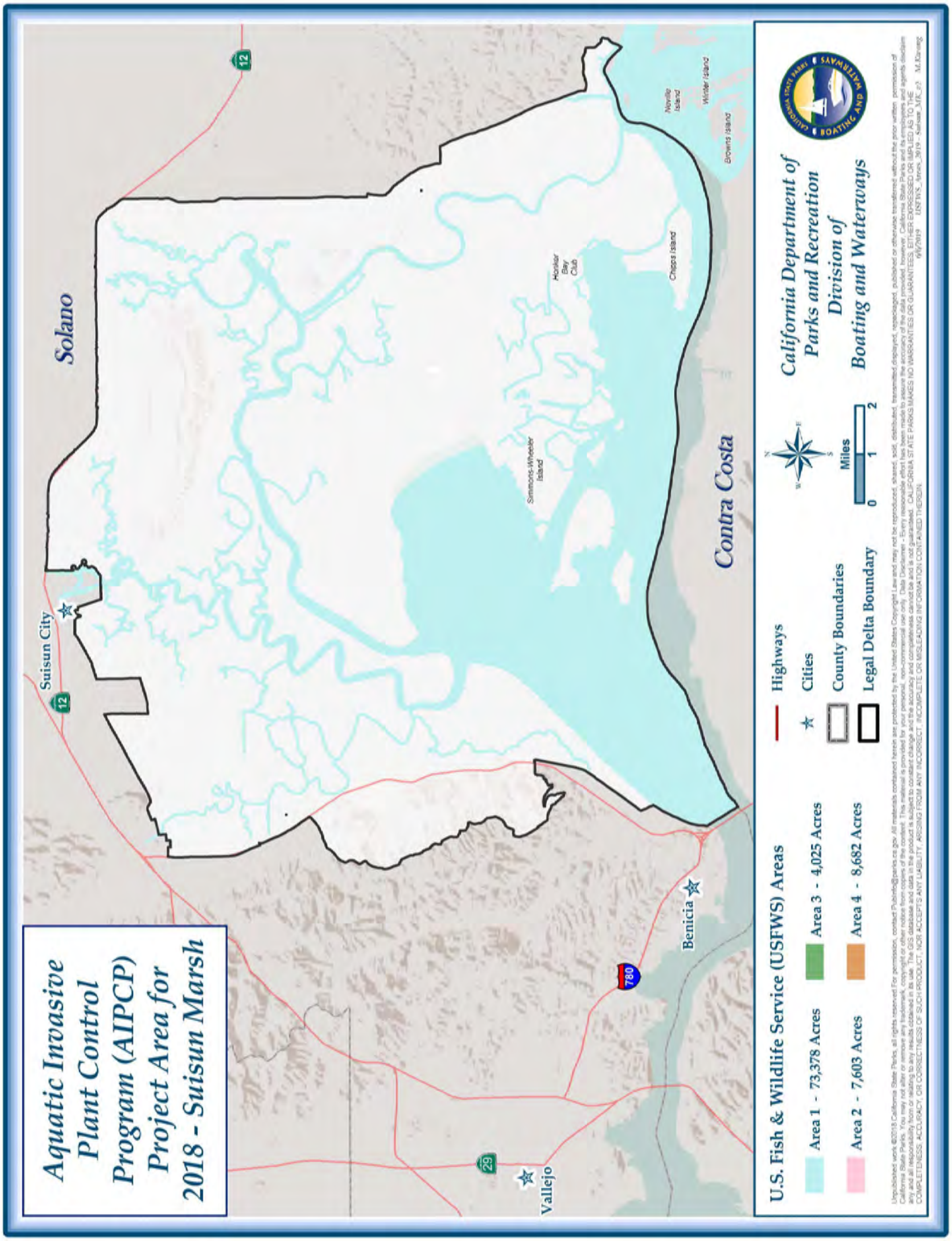

Aquatic Invasive Plant Control Program (AIPCP) Project Area for 2018 - Suisun Marsh
Solano
Contra Costa
Suisun City
Benicia
Vallejo
12
29
780
Simmons-Wheeler Island
Chipps Island
Browns Island
Winter Island
Seville Island
U.S. Fish & Wildlife Service (USFWS) Areas
Area 1 - 73,378 Acres
Area 2 - 7,603 Acres
Area 3 - 4,025 Acres
Area 4 - 8,682 Acres
Highways
Cities
County Boundaries
Legal Delta Boundary
Miles
0
1
2
California Department of Parks and Recreation
Division of
Boating and Waterways

Figure A-3. FAV Southern Sites and USFWS Areas

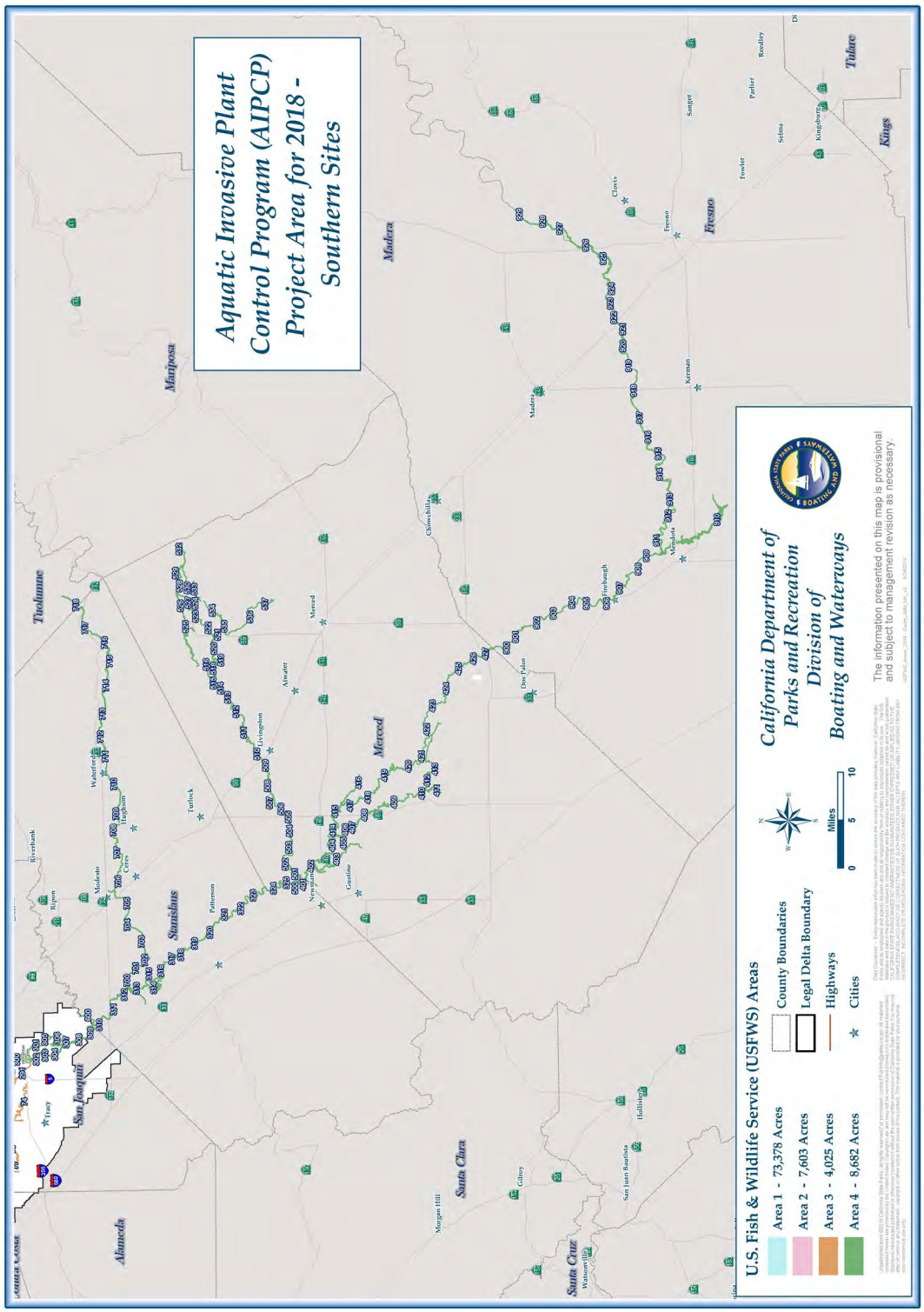
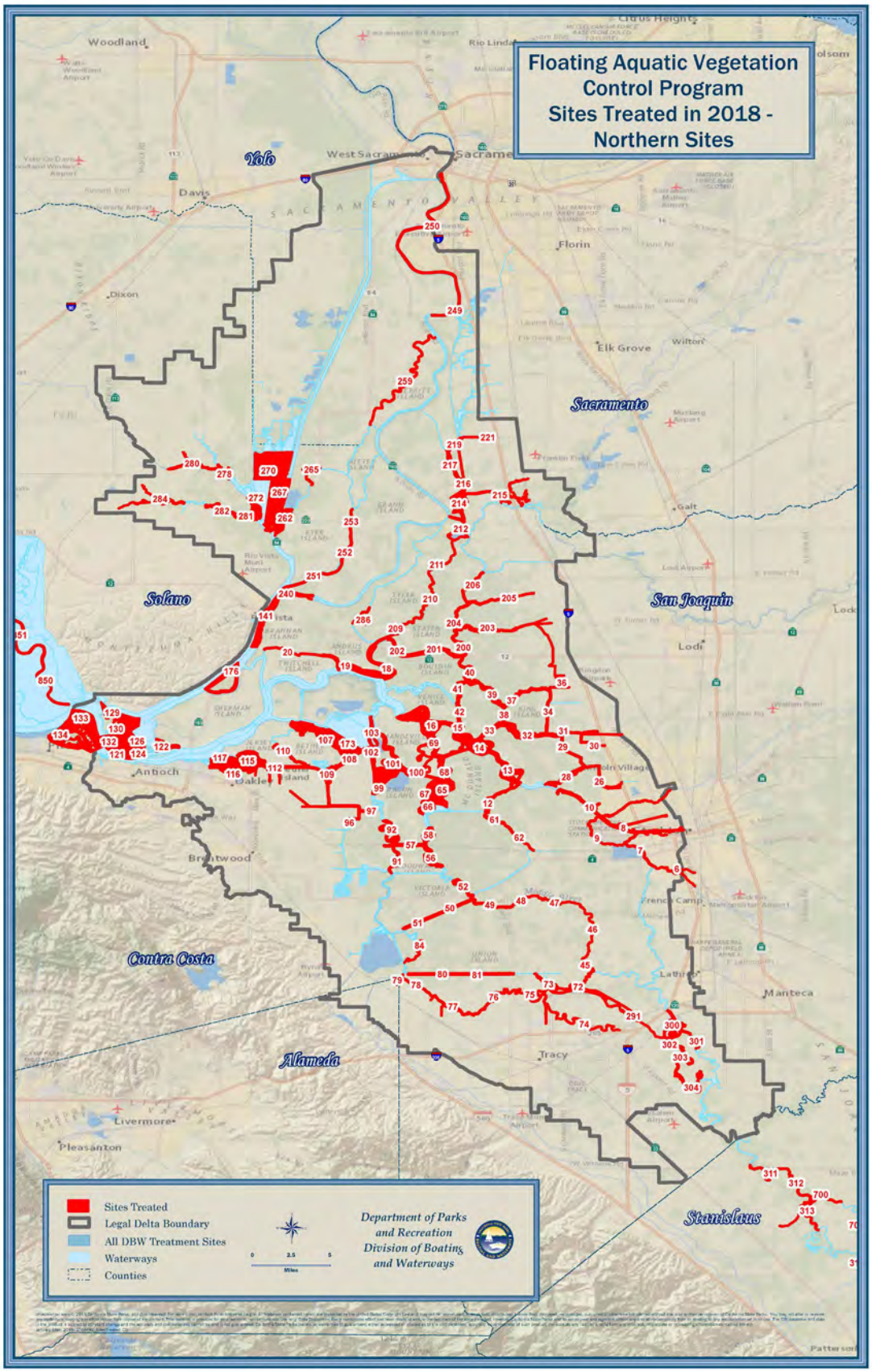

Aquatic Invasive Plant Control Program (AIPCP) Project Area for 2018 - Southern Sites
U.S. Fish & Wildlife Service (USFWS) Areas
Area 1 - 73,378 Acres
Area 2 - 7,603 Acres
Area 3 - 4,025 Acres
Area 4 - 8,682 Acres
County Boundaries
Legal Delta Boundary
Highways
Cities
Miles
0
5
10
California Department of Parks and Recreation Division of Boating and Waterways
The information presented on this map is provisional and subject to management revision as necessary.
Tuolumne
Mariposa
Madera
Fresno
Kings
Tulare
Alameda
San Joaquin
Stanislaus
Merced
Santa Clara
Santa Cruz

Figure A-4. 2018 FAV Northern Treated Sites


Floating Aquatic Vegetation Control Program
Sites Treated in 2018 - Northern Sites
Yolo
Solano
Sacramento
San Joaquin
Contra Costa
Alameda
Stanislaus
Woodland
Davis
West Sacramento
Sacramento
Florin
Elk Grove
Wilton
Galt
Dixon
Lodi
Antioch
Oakley
Brentwood
French Camp
Manteca
Tracy
Lathrop
Livermore
Pleasanton
Sites Treated
Legal Delta Boundary
All DBW Treatment Sites
Waterways
Counties
Department of Parks and Recreation
Division of Boating and Waterways

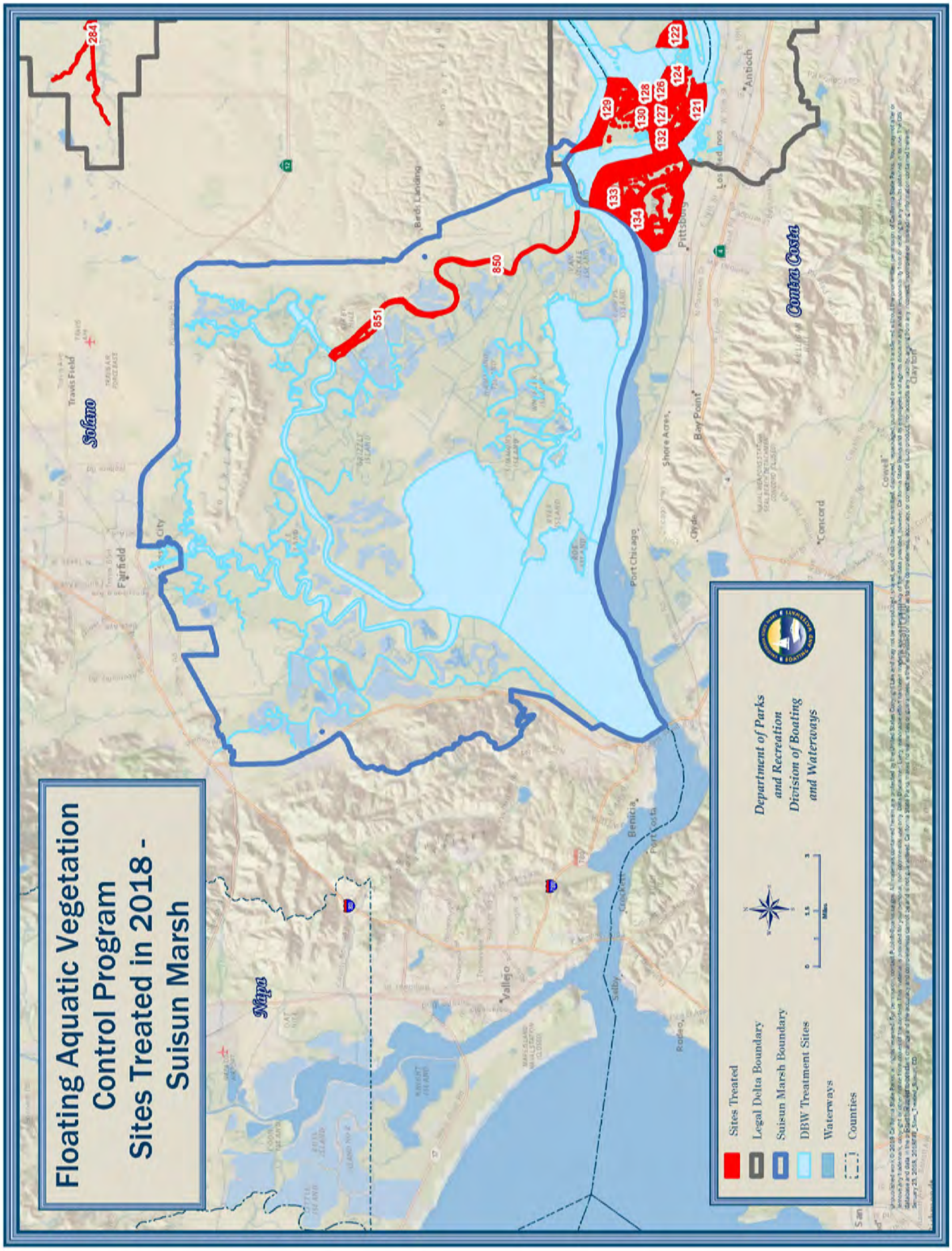

Floating Aquatic Vegetation
Control Program
Sites Treated in 2018 -
Suisun Marsh
Sites Treated
Legal Delta Boundary
Suisun Marsh Boundary
DBW Treatment Sites
Waterways
Counties
Department of Parks
and Recreation
Division of Boating
and Waterways
Solano
Napa
Contra Costa
284
122
124
121
128
126
127
129
130
132
133
134
850
851
Pittsburg
Antioch
Bay Point
Shore Acres
Port Chicago
Concord
Clayton
Benicia
Vallejo
Fairfield
Travis Field
Birds Landing

Figure A-5. 2018 FAV Southern Treatment Sites

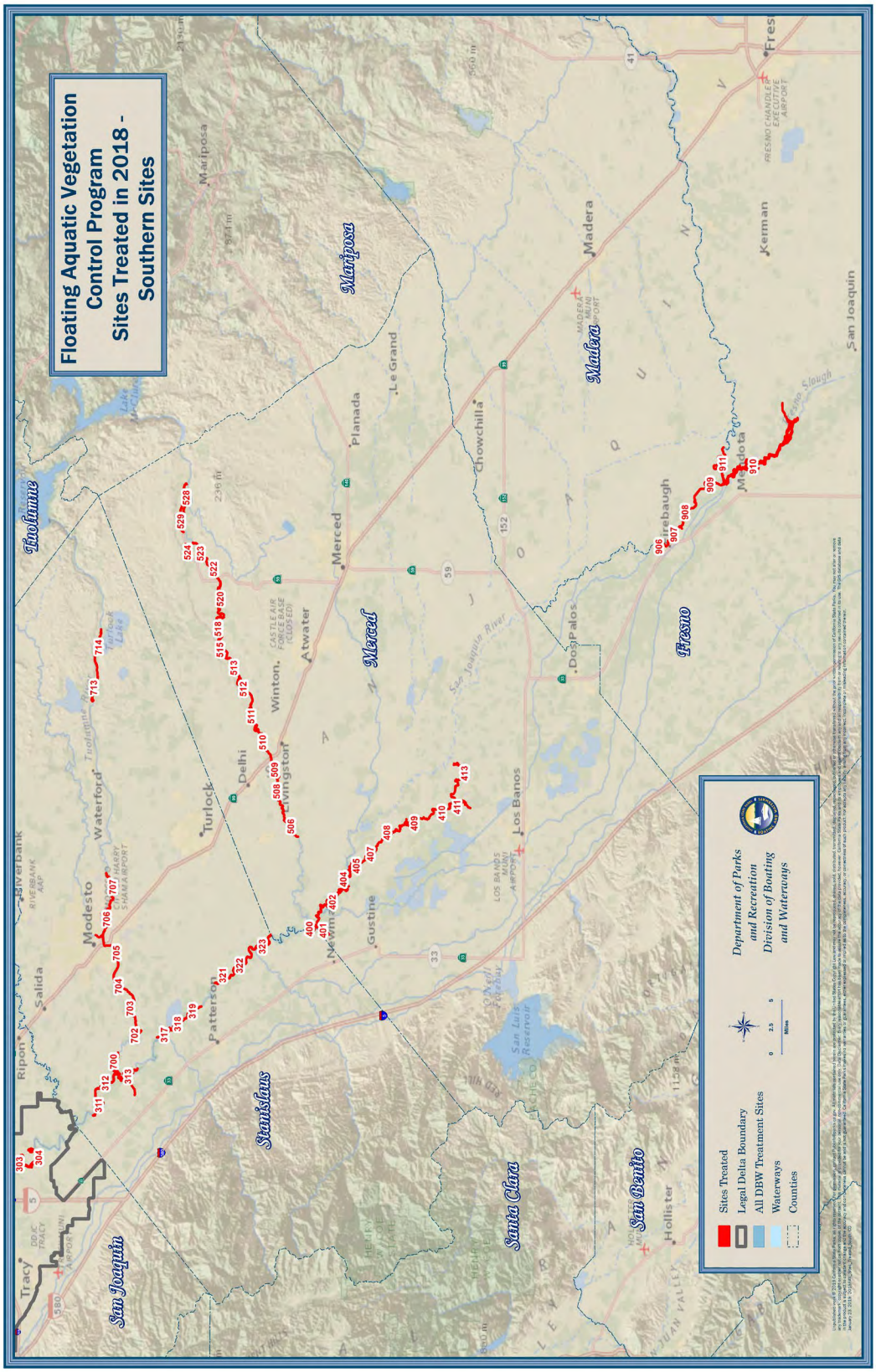
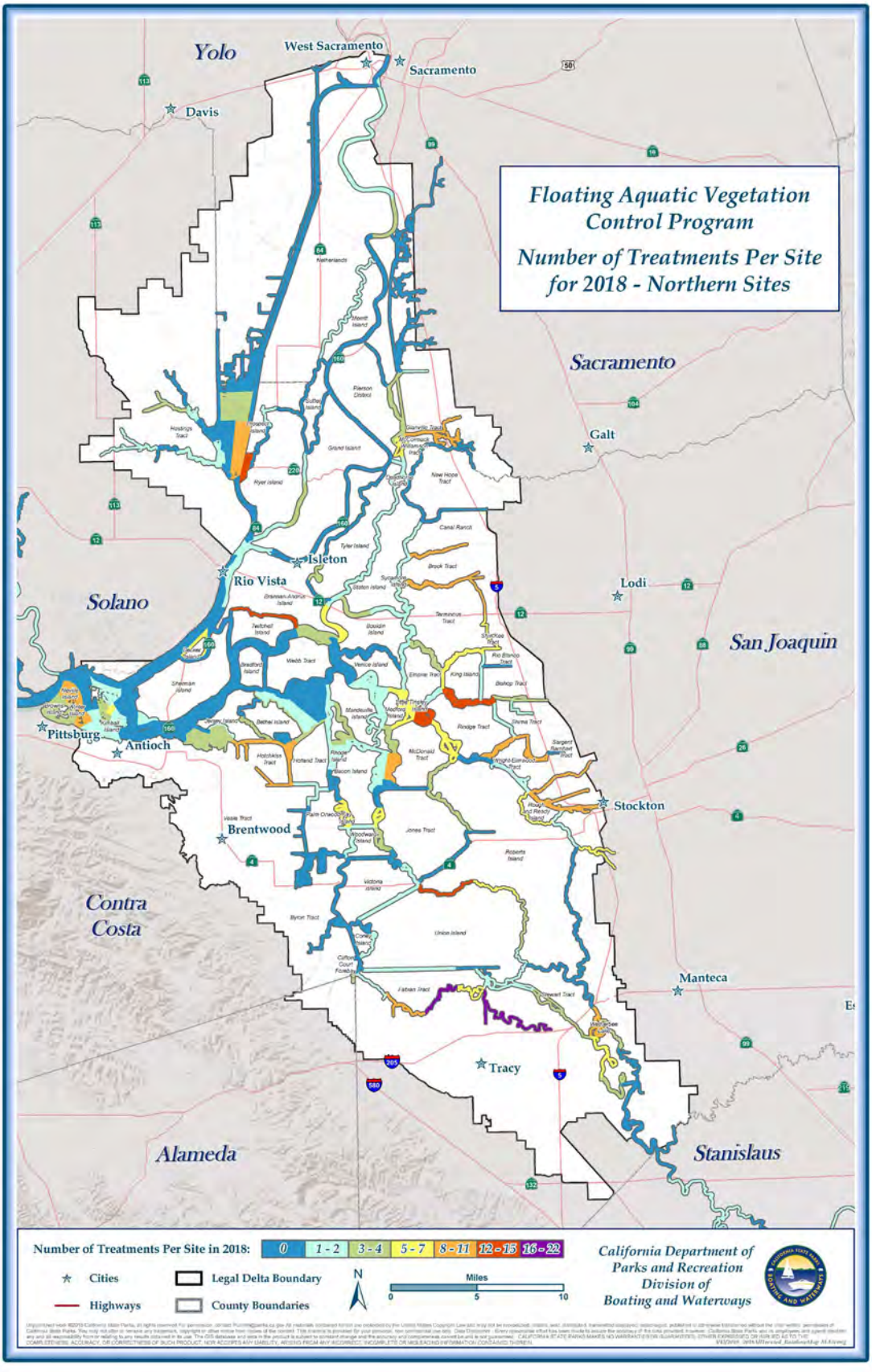

Floating Aquatic Vegetation Control Program
Sites Treated in 2018 - Southern Sites
Sites Treated
Legal Delta Boundary
All DBW Treatment Sites
Waterways
Counties
Department of Parks and Recreation
Division of Boating and Waterways
San Joaquin
Stanislaus
Santa Clara
San Benito
Tuolumne
Mariposa
Merced
Madera
Fresno
Tracy
Ripon
Salida
Modesto
Waterford
Riverbank
Turlock
Delhi
Winton
Atwater
Merced
Planada
Le Grand
Chowchilla
Madera
Dos Palos
Los Banos
Gustine
Newman
Patterson
Hollister
Firebaugh
Mendota
Kerman

Figure A-6. 2018 Treatment Count Northern Sites


Floating Aquatic Vegetation Control Program
Number of Treatments Per Site for 2018 - Northern Sites
Yolo
West Sacramento
Sacramento
Davis
Sacramento
Galt
Isleton
Rio Vista
Solano
Lodi
San Joaquin
Pittsburg
Antioch
Stockton
Brentwood
Contra Costa
Manteca
Tracy
Alameda
Stanislaus
Number of Treatments Per Site in 2018:
0
1 - 2
3 - 4
5 - 7
8 - 11
12 - 15
16 - 22
Cities
Highways
Legal Delta Boundary
County Boundaries
N
Miles
0
5
10
California Department of Parks and Recreation
Division of Boating and Waterways

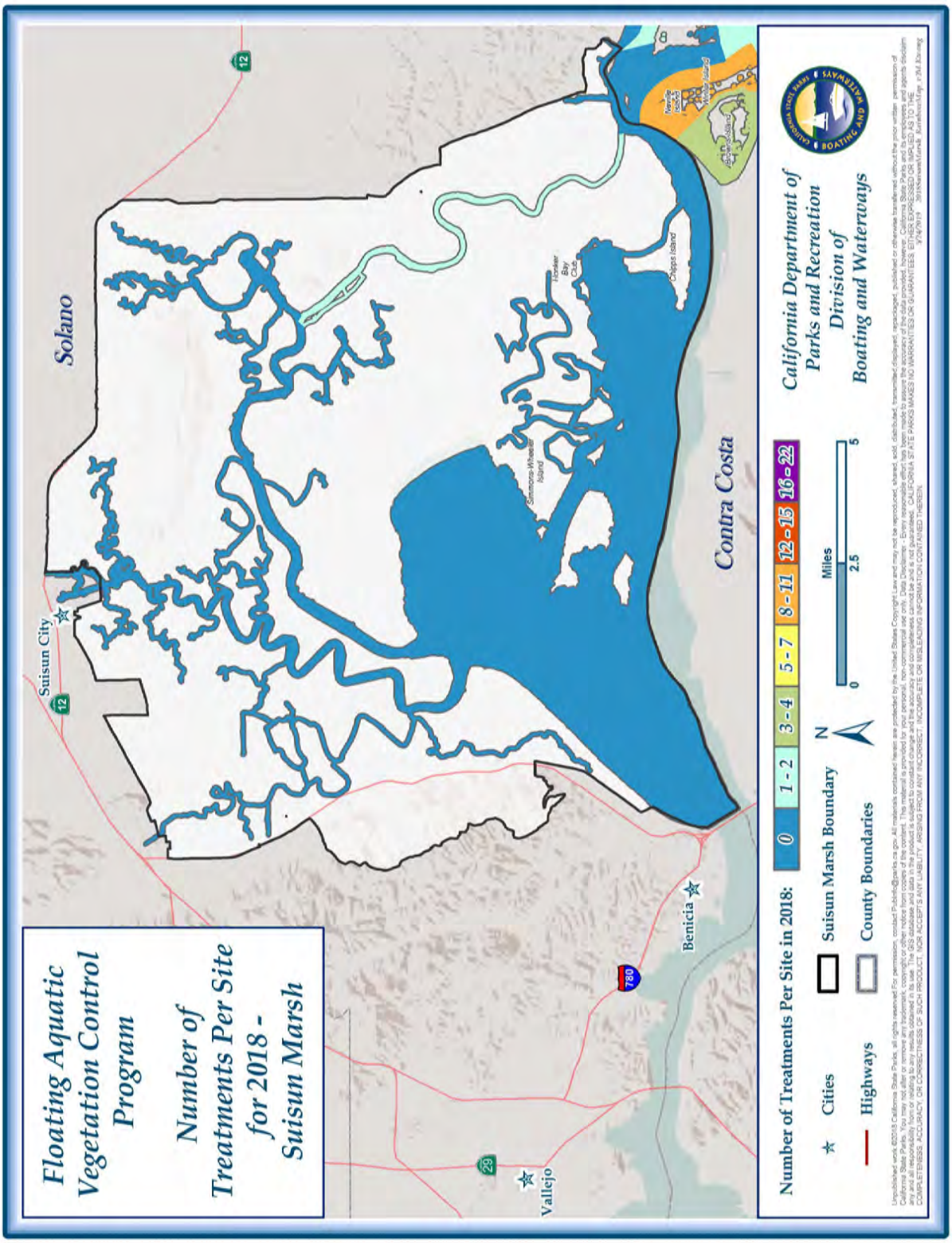

Floating Aquatic Vegetation Control Program
Number of Treatments Per Site for 2018 - Suisun Marsh
Solano
Contra Costa
Suisun City
Benicia
Vallejo
Simmons Wheeler Island
Horseshoe Bay Cut
Chipps Island
Number of Treatments Per Site in 2018:
0
1 - 2
3 - 4
5 - 7
8 - 11
12 - 15
16 - 22
Cities
Highways
Suisun Marsh Boundary
County Boundaries
N
Miles
0
2.5
5
California Department of Parks and Recreation
Division of Boating and Waterways

Figure A-7. 2018 Treatment Count Southern Sites

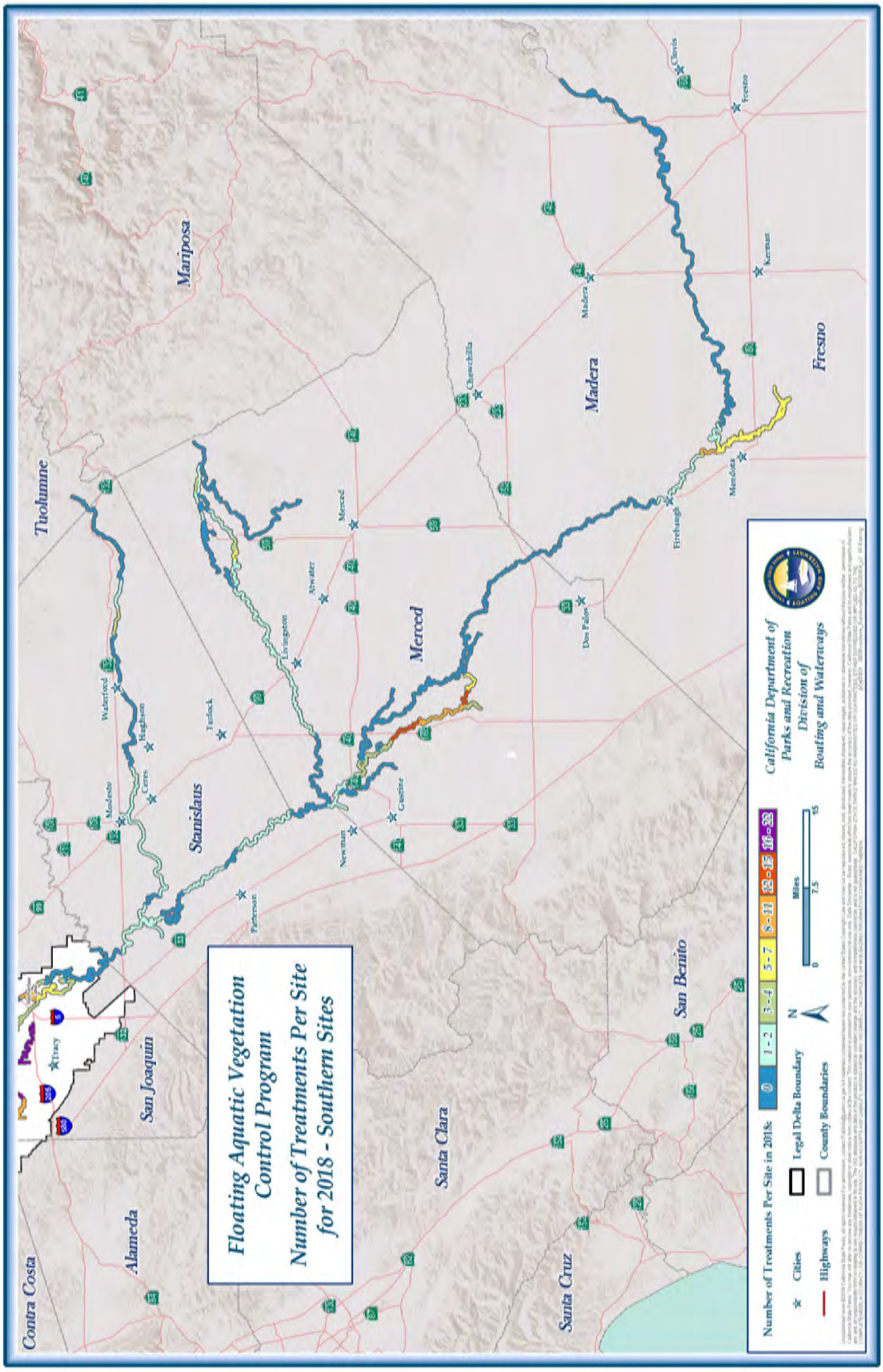
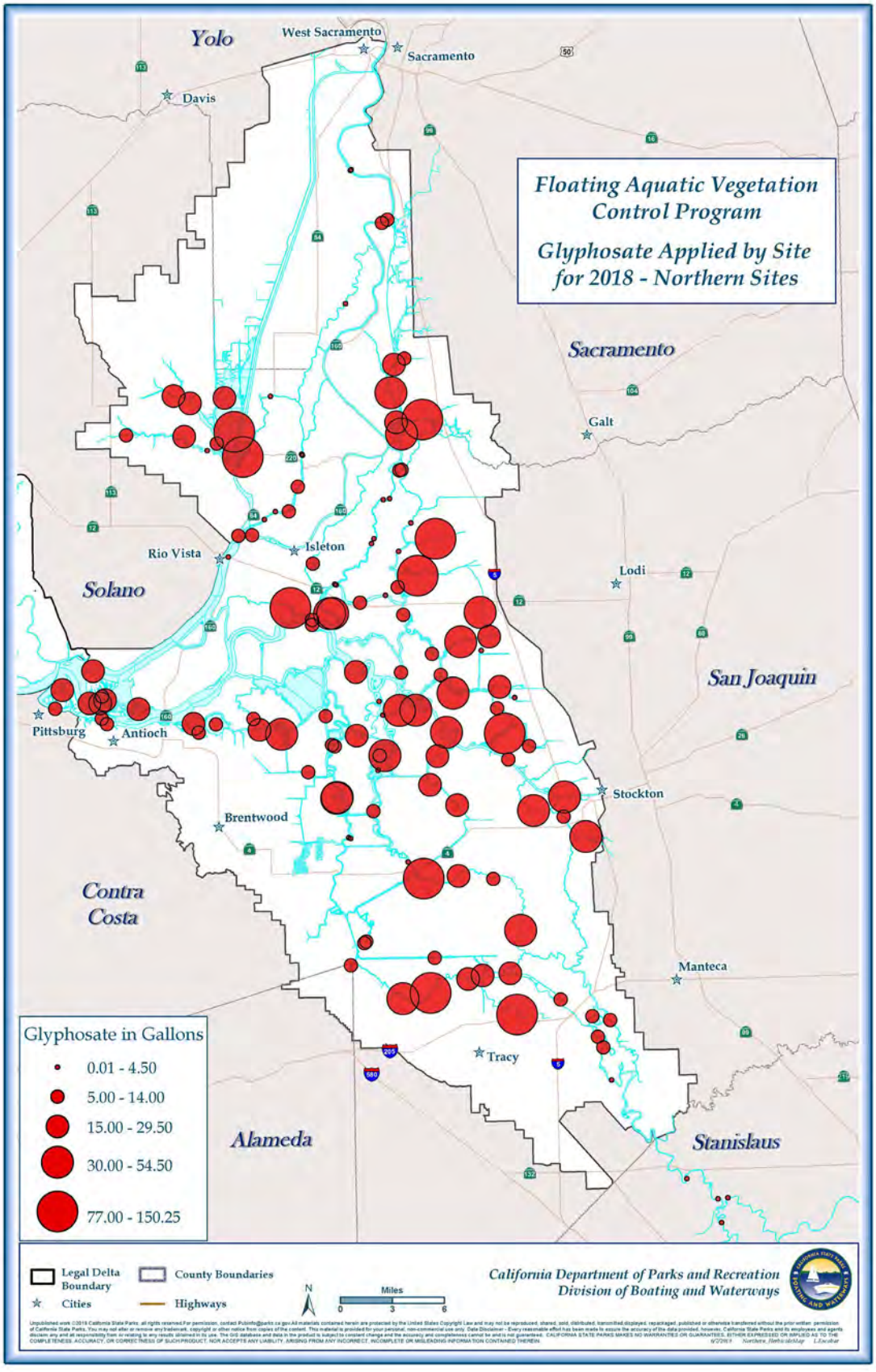
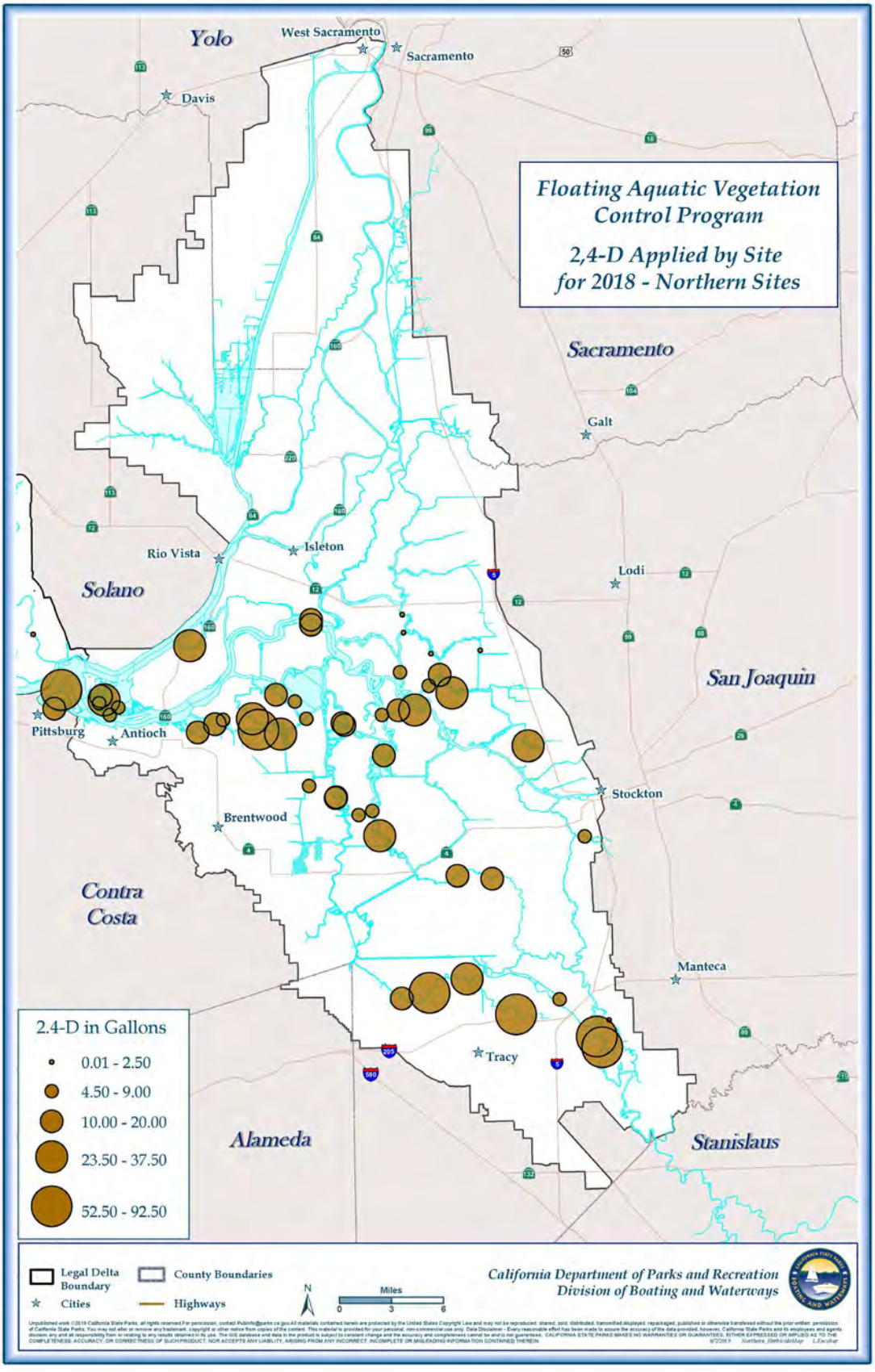
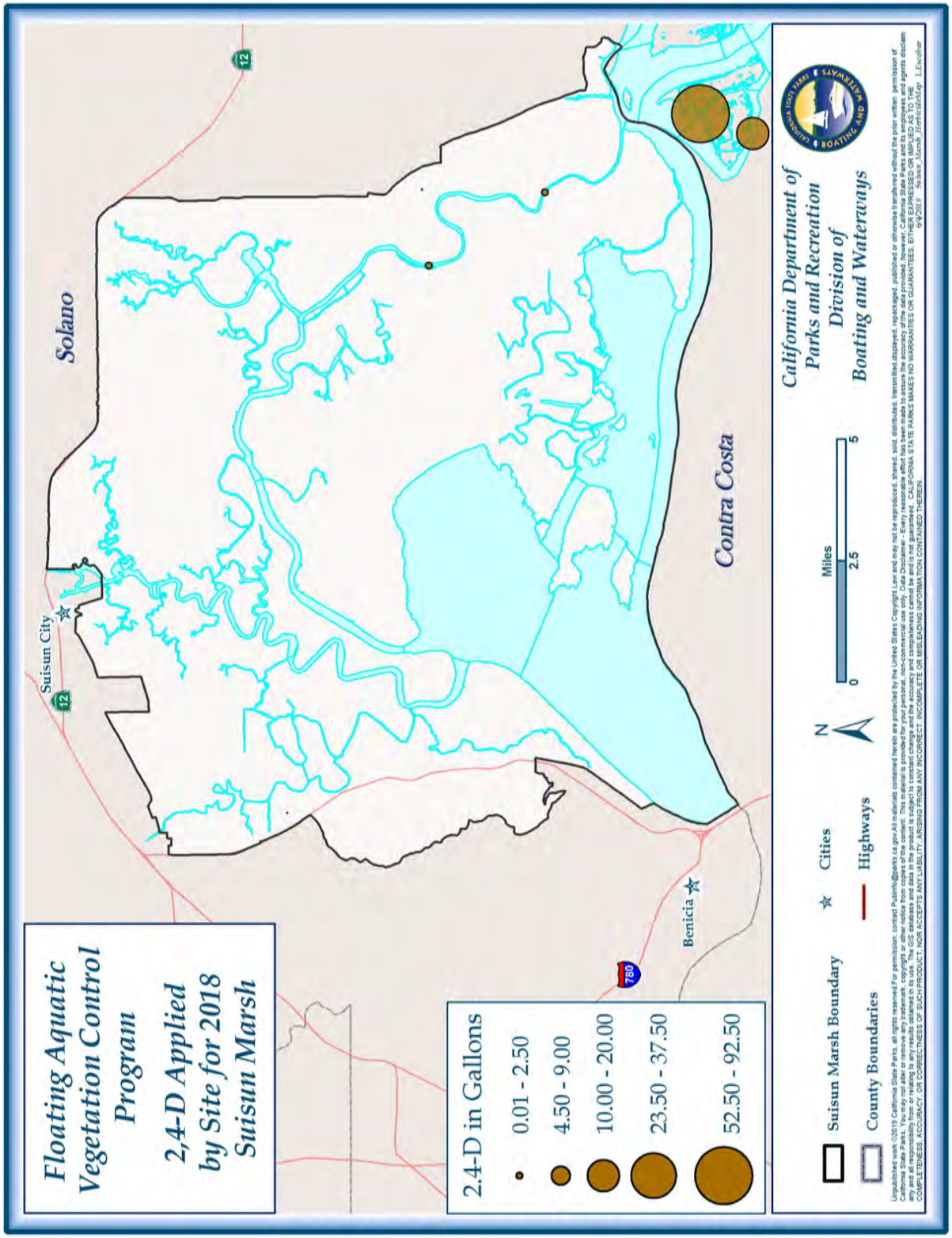

Floating Aquatic Vegetation Control Program
Number of Treatments Per Site for 2018 - Southern Sites
Contra Costa
Alameda
San Joaquin
Stanislaus
Tuolumne
Mariposa
Merced
Madera
Fresno
Santa Clara
San Benito
Santa Cruz
Number of Treatments Per Site in 2018:
0
1 - 2
3 - 4
5 - 7
8 - 11
12 - 15
16 - 22
Cities
Highways
Legal Delta Boundary
County Boundaries
N
Miles
0
7.5
15
California Department of Parks and Recreation
Division of Boating and Waterways

Figure A-8. 2018 Herbicide Use Northern Sites


Floating Aquatic Vegetation Control Program
Glyphosate Applied by Site for 2018 - Northern Sites
Yolo
West Sacramento
Sacramento
Davis
Sacramento
Galt
Rio Vista
Isleton
Solano
Lodi
San Joaquin
Pittsburg
Antioch
Stockton
Brentwood
Contra Costa
Manteca
Tracy
Alameda
Stanislaus
Glyphosate in Gallons
0.01 - 4.50
5.00 - 14.00
15.00 - 29.50
30.00 - 54.50
77.00 - 150.25
Legal Delta Boundary
County Boundaries
Cities
Highways
N
Miles
0 3 6
California Department of Parks and Recreation
Division of Boating and Waterways


Floating Aquatic Vegetation Control Program
2,4-D Applied by Site for 2018 - Northern Sites
Yolo
West Sacramento
Sacramento
Davis
Sacramento
Galt
Rio Vista
Isleton
Solano
Lodi
San Joaquin
Pittsburg
Antioch
Stockton
Brentwood
Contra Costa
Manteca
Tracy
Alameda
Stanislaus
2.4-D in Gallons
0.01 - 2.50
4.50 - 9.00
10.00 - 20.00
23.50 - 37.50
52.50 - 92.50
Legal Delta Boundary
Cities
County Boundaries
Highways
N
Miles
0 3 6
California Department of Parks and Recreation
Division of Boating and Waterways


Floating Aquatic Vegetation Control Program
2,4-D Applied by Site for 2018 Suisun Marsh
Solano
Contra Costa
Suisun City
Benicia
12
780
2.4-D in Gallons
0.01 - 2.50
4.50 - 9.00
10.00 - 20.00
23.50 - 37.50
52.50 - 92.50
Suisun Marsh Boundary
County Boundaries
Cities
Highways
N
Miles
0
2.5
5
California Department of Parks and Recreation
Division of Boating and Waterways

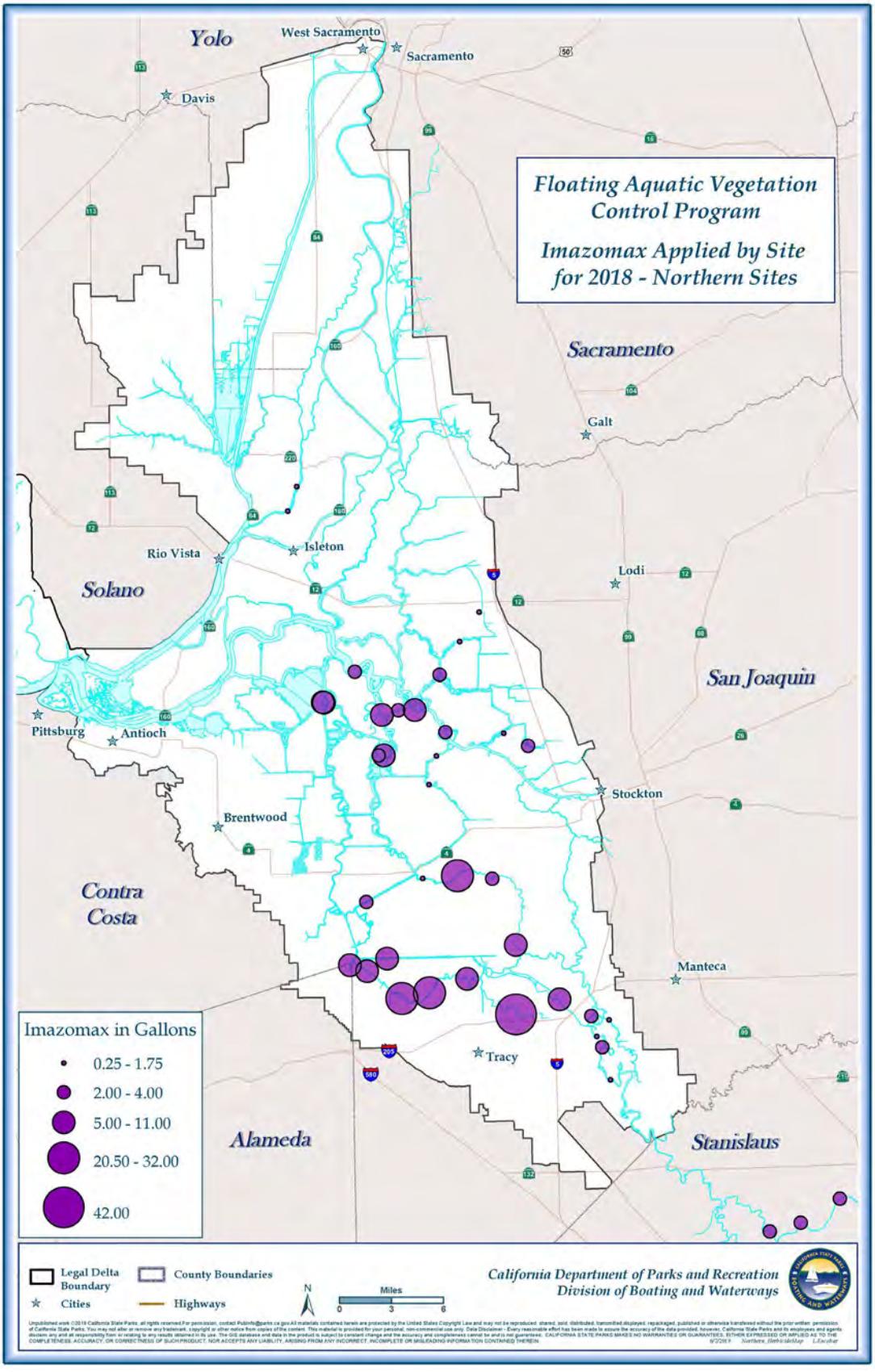

Floating Aquatic Vegetation Control Program
Imazomax Applied by Site for 2018 - Northern Sites
Yolo
West Sacramento
Sacramento
Davis
Sacramento
Galt
Rio Vista
Isleton
Solano
Lodi
San Joaquin
Pittsburg
Antioch
Stockton
Brentwood
Contra Costa
Manteca
Tracy
Alameda
Stanislaus
Imazomax in Gallons
0.25 - 1.75
2.00 - 4.00
5.00 - 11.00
20.50 - 32.00
42.00
Legal Delta Boundary
Cities
County Boundaries
Highways
N
Miles
0 3 6
California Department of Parks and Recreation
Division of Boating and Waterways

Figure A-9. 2018 Herbicide Use Southern Sites

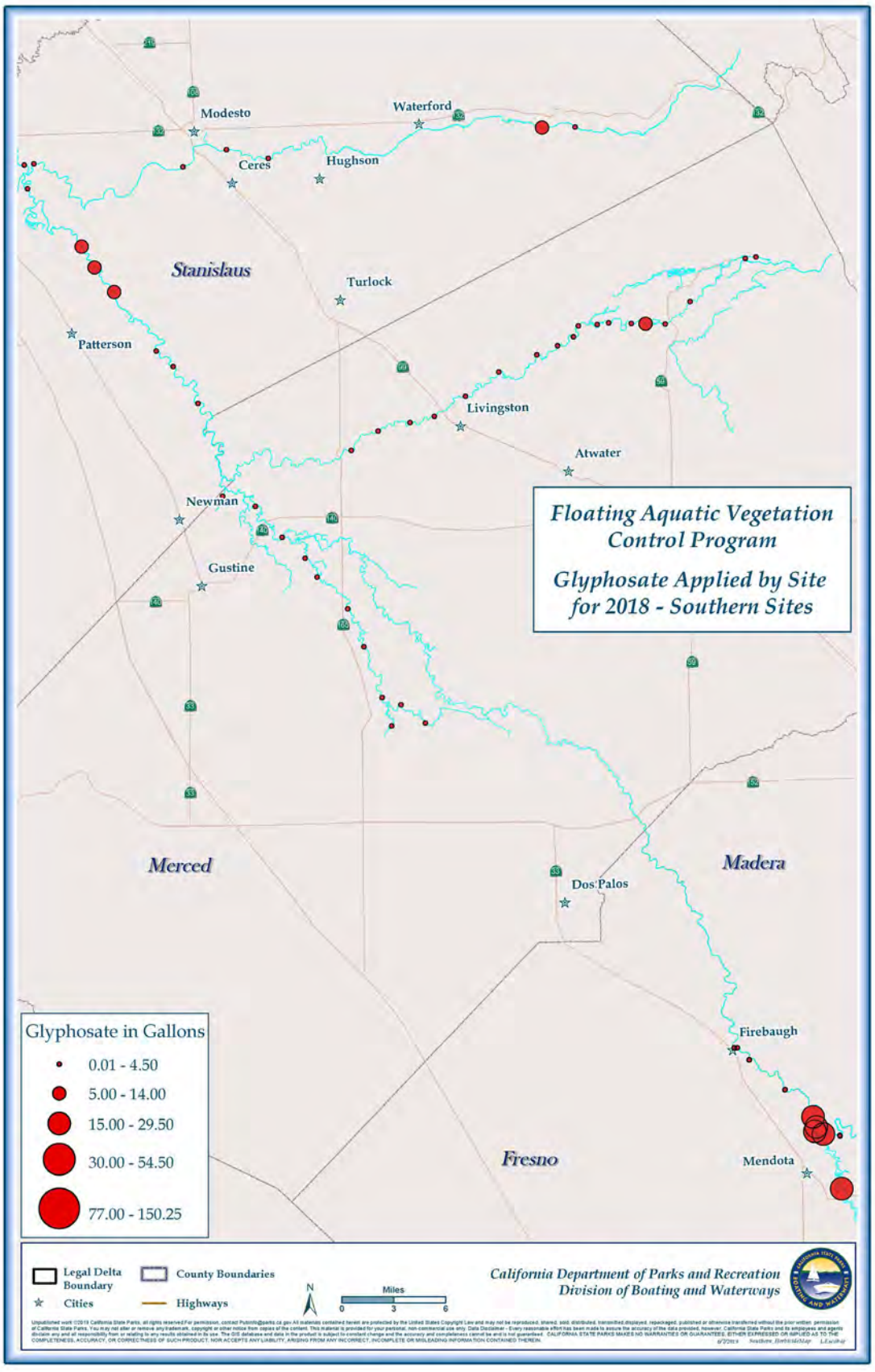

Modesto
Waterford
Ceres
Hughson
Stanislaus
Turlock
Patterson
Livingston
Atwater
Newman
Gustine
Floating Aquatic Vegetation Control Program
Glyphosate Applied by Site for 2018 - Southern Sites
Merced
Madera
Dos Palos
Firebaugh
Fresno
Mendota
Glyphosate in Gallons
0.01 - 4.50
5.00 - 14.00
15.00 - 29.50
30.00 - 54.50
77.00 - 150.25
Legal Delta Boundary
County Boundaries
Cities
Highways
N
Miles
0 3 6
California Department of Parks and Recreation
Division of Boating and Waterways

Figure A-10. 2018 FAV Mechanical Harvesting Sites

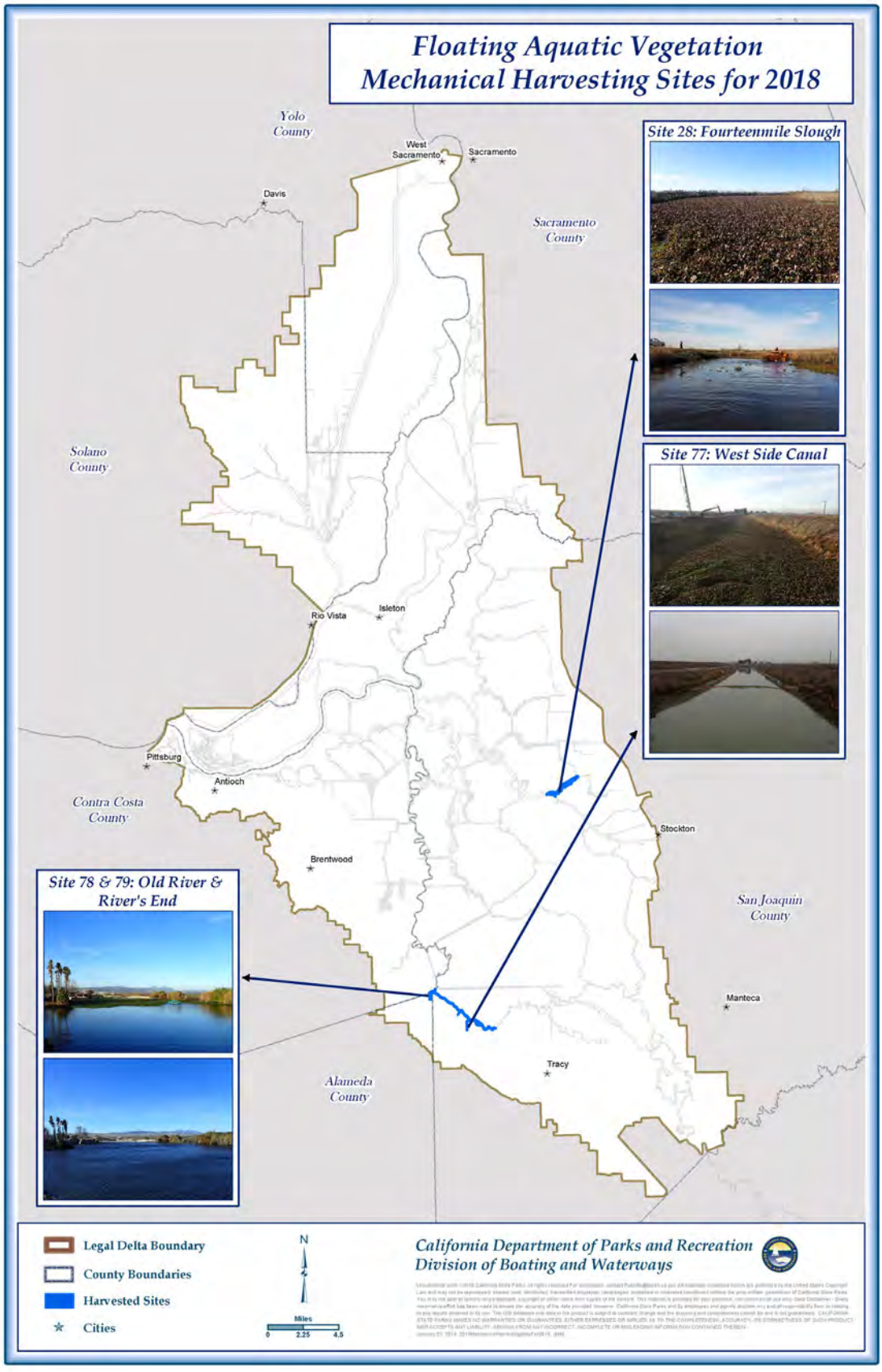
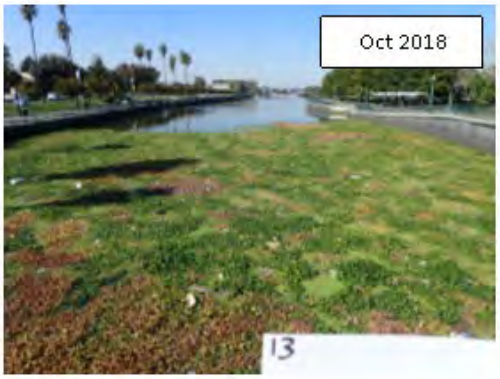

Floating Aquatic Vegetation
Mechanical Harvesting Sites for 2018
Yolo County
West Sacramento
Sacramento
Davis
Sacramento County
Site 28: Fourteenmile Slough
Solano County
Site 77: West Side Canal
Rio Vista
Isleton
Pittsburg
Antioch
Contra Costa County
Stockton
Brentwood
Site 78 & 79: Old River & River's End
San Joaquin County
Manteca
Tracy
Alameda County
Legal Delta Boundary
County Boundaries
Harvested Sites
Cities
N
Miles
0 2.25 4.5
California Department of Parks and Recreation
Division of Boating and Waterways

Figure A-11. 2018 FAV Photo Point Monitoring Sites by Land

Note: Some sites are missing pictures for certain dates. Some sites were removed from the photo-monitoring protocol because current staffing levels did not allow continued monitoring.

Site 1 - San Joaquin River/Mossdale

Site 8 - Port of Stockton



Site 15 - Columbia Cut/Deep Water

Site 20- Sevenmile Slough

Site 31—Bear Creek/Pixley Slough

Site 34- Bishop Cut

Site 36—White Slough

Site 46– Middle River

Site 47 - Union Island/Middle River

Site 62– Whiskey Slough

Site 63— Trapper Slough

Site 74 – Tom Paine/Sugar Slough

Not Available

Not Available

Site 75 - Old River

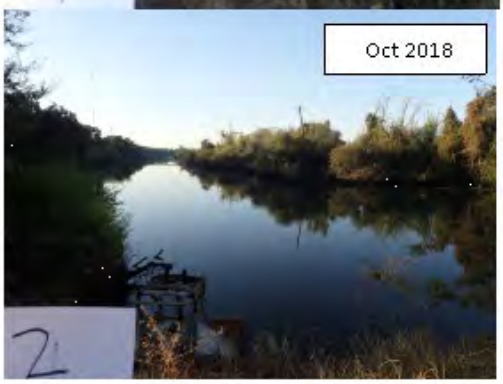
Site 76 - Old River

Site 82 - Grant Line Canal

Site 91 - Old River

Site 97 - Rock Slough

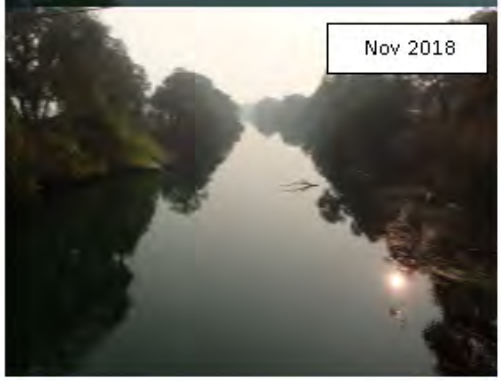
Site 216 - Snodgrass Slough



Site 259 - Elk Slough

Not Available

Not Available



Site 265 - Miner Slough

Not Available

Site 266 - Miner Slough

Not Available

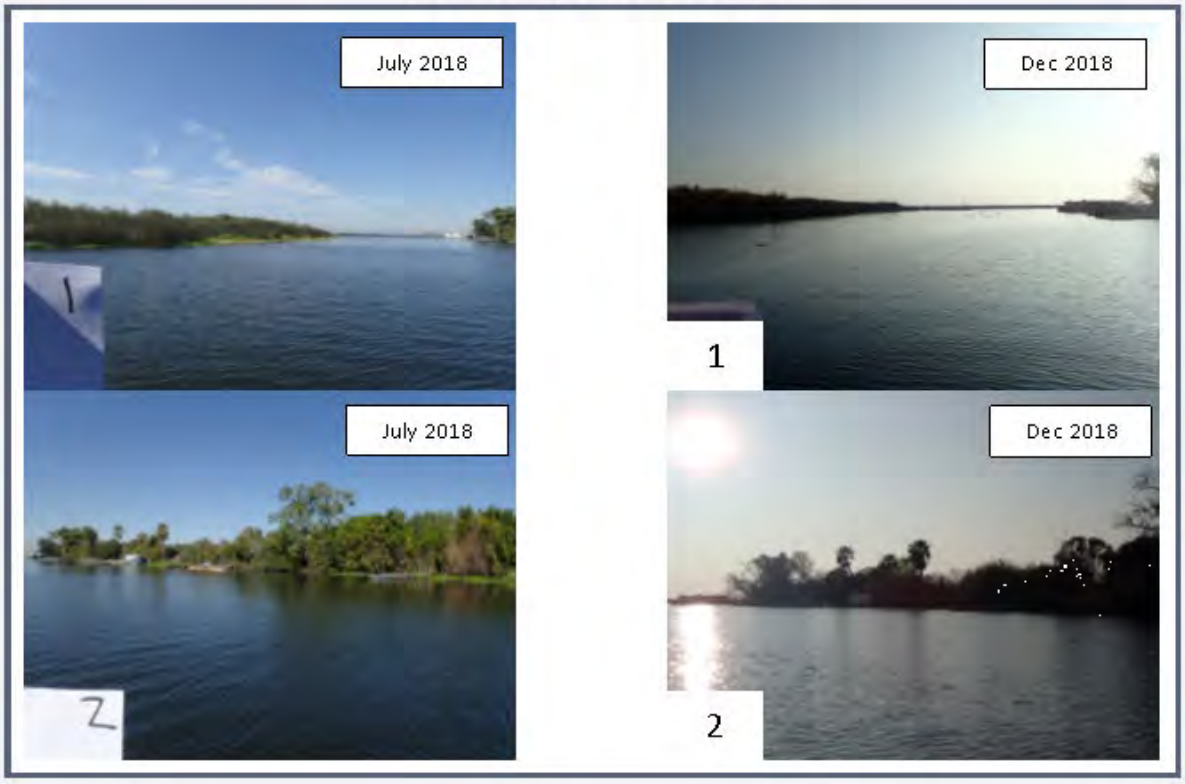
Site 291 - Paradise Cut

Figure A-12. 2018 FAV Photo Point Monitoring Sites by Water

Note: Some sites are missing pictures for certain dates. Some sites were removed from the photo-monitoring protocol because current staffing levels did not allow continued monitoring.

Site 15 - Columbia Cut/Headreach Island

Site 32 - Disappointment Slough



Site 59 - Empire Cut

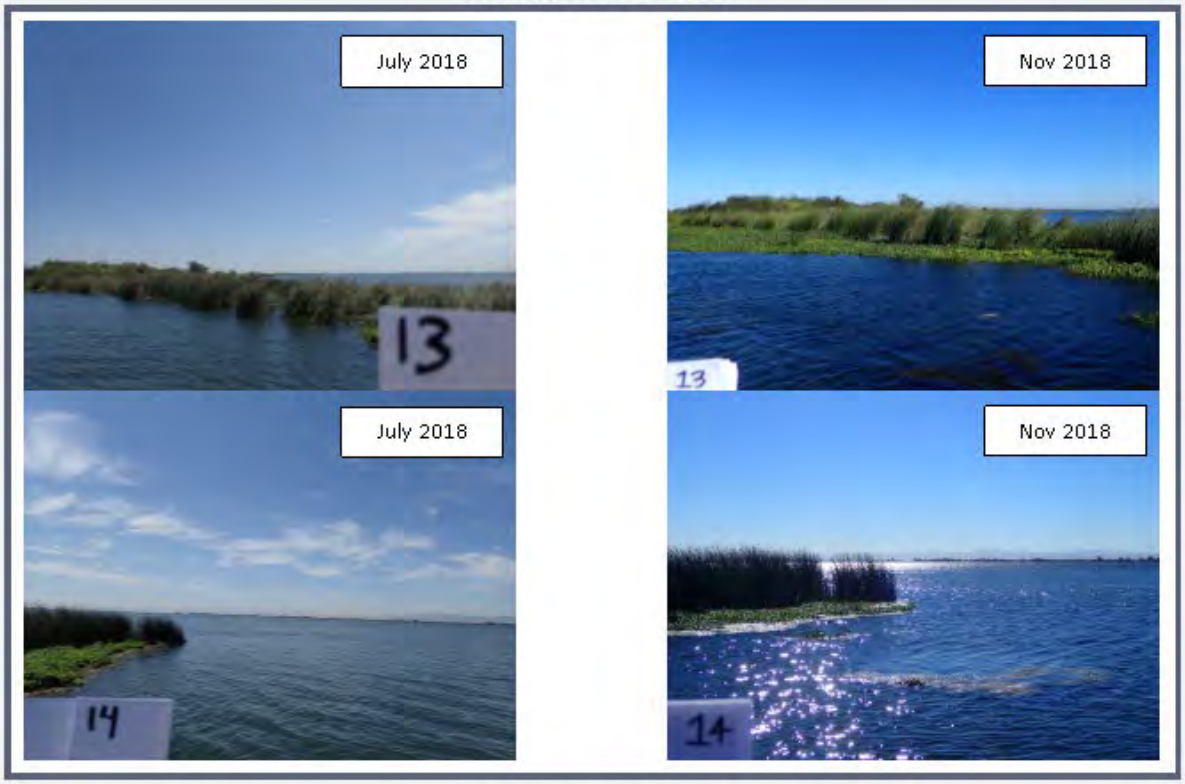
Site 92—Old River

92

Site 110 - Taylor Slough

Site 112 - Dutch Slough

Site 173 - Frank's Tract



Site 176 - Decker Slough

Site 203 - Sycamore Slough

Site 205 - Hog Slough

Not Available

Not Available

Site 262 - Prospect Slough

Site 267 - Cache Slough

Site 286 - Georgiana Slough

Not Available

Not Available

APPENDIX B

2018 Herbicide Application Daily Logs

Table B-1. March 2018 Herbicide and Adjuvant Use

No herbicide treatments occurred in March 2018

Table B-2. April 2018 Herbicide and Adjuvant Use

Date	Vessel ID	Site ID	County	Before Temp	After Temp	Time Arrived	Time Departed	DO Before	DO After	2,4-D	Glyphosate	Imazamox	Penoxsulam	Agridex	Competitor	Chem Rate	2,4-D Acres	Glyphosate Acres	Imazamox Acres	Penoxsulam Acres	Wind Speed
4/3/2018	0006	49	San Joaquin	25.20	28.20	930	1400	7.20	6.80	0.00	4.50	0.50	0.00	0.00	2.50	128	0.00	4.50	0.50	0.00	2-4
4/4/2018	9980	300	San Joaquin	16.90	16.80	900	945	6.50	6.75	0.00	0.50	0.00	0.00	0.25	0.00	120	0.00	0.53	0.00	0.00	2-4
4/4/2018	9980	302	San Joaquin	17.00	17.10	1000	1100	7.14	7.33	0.00	0.50	0.00	0.00	0.25	0.00	120	0.00	0.53	0.00	0.00	4-6
4/10/2018	9980	302	San Joaquin	16.40	16.40	800	915	6.72	7.70	0.00	1.50	0.00	0.00	1.00	0.00	120	0.00	1.60	0.00	0.00	2-4
4/10/2018	9980	304	San Joaquin	18.00	17.90	945	1100	9.50	8.70	0.00	0.75	0.00	0.00	0.25	0.00	120	0.00	0.80	0.00	0.00	4-6
4/18/2018	8835	49	San Joaquin	15.80	16.00	930	1400	6.20	7.10	0.00	2.00	1.00	0.00	1.25	0.00	138	0.00	1.86	0.93	0.00	0-2
4/18/2018	9980	49	San Joaquin	14.70	15.10	900	1400	8.59	9.22	0.00	2.00	0.00	0.00	1.00	0.00	120	0.00	2.13	0.00	0.00	2-4
4/23/2018	3420	14	San Joaquin	15.10	16.20	1000	1430	9.20	8.50	0.00	5.00	0.00	0.00	2.50	0.00	120	0.00	5.33	0.00	0.00	2-4
4/23/2018	MERCED	410	Merced	21.30	23.20	930	1400	5.72	6.25	0.00	0.05	0.00	0.00	0.02	0.00	96	0.00	0.07	0.00	0.00	0-2
4/24/2018	MERCED	409	Merced	20.80	23.00	810	1300	5.20	5.54	0.00	0.06	0.00	0.00	0.03	0.00	96	0.00	0.08	0.00	0.00	2-4
4/24/2018	MERCED	410	Merced	23.00	23.30	1300	1345	5.54	5.53	0.00	0.03	0.00	0.00	0.02	0.00	96	0.00	0.04	0.00	0.00	4-6
4/25/2018	0080	28	San Joaquin	18.00	19.20	1130	1500	8.20	8.30	0.00	2.50	0.00	0.00	1.25	0.00	120	0.00	2.67	0.00	0.00	4-6
4/25/2018	3420	14	San Joaquin	16.30	16.50	1230	1530	9.20	9.50	0.00	3.00	0.00	0.00	1.25	0.00	120	0.00	3.20	0.00	0.00	4-6
4/25/2018	8835	48	San Joaquin	16.00	15.90	930	1400	7.20	6.70	0.00	2.50	2.00	0.00	0.00	2.00	128	0.00	2.50	2.00	0.00	4-6
4/25/2018	9123	92	San Joaquin	19.40	20.90	1030	1330	10.30	10.50	0.00	5.00	0.00	0.00	2.50	0.00	120	0.00	5.33	0.00	0.00	4-6
4/25/2018	9980	47	San Joaquin	19.80	21.20	900	1345	7.82	8.14	0.00	2.75	0.00	0.00	1.25	0.00	120	0.00	2.93	0.00	0.00	2-4
4/25/2018	MERCED	411	Merced	19.40	22.00	830	1330	6.96	6.16	0.00	0.14	0.00	0.00	0.07	0.00	0	0.00	0.00	0.00	0.00	2-4
4/26/2018	9980	303	San Joaquin	18.10	19.20	930	1300	7.56	7.32	0.00	0.75	0.25	0.00	0.50	0.00	120	0.00	0.80	0.27	0.00	4-6
4/26/2018	MERCED	410	Merced	24.00	23.90	1200	1300	6.00	5.78	0.00	0.02	0.00	0.00	0.01	0.00	96	0.00	0.03	0.00	0.00	2-4
4/26/2018	MERCED	411	Merced	17.40	24.00	810	1200	5.97	6.00	0.00	0.05	0.00	0.00	0.02	0.00	96	0.00	0.07	0.00	0.00	4-6
4/27/2018	MERCED	529	Merced	15.40	17.80	830	1300	9.31	9.16	0.00	0.08	0.00	0.00	0.00	0.00	96	0.00	0.11	0.00	0.00	6-8
4/30/2018	MERCED	412	Merced	16.50	19.80	1100	1320	7.81	7.41	0.00	0.03	0.00	0.00	0.02	0.00	0	0.00	0.00	0.00	0.00	4-6
4/30/2018	MERCED	413	Merced	15.10	16.50	830	1100	8.35	7.81	0.00	0.05	0.00	0.00	0.02	0.00	0	0.00	0.00	0.00	0.00	4-6
										0.00	33.76	3.75	0.00	13.46	4.50		0.00	35.11	3.69	0.00	

Table B-3. May 2018 Herbicide and Adjuvant Use

Date	Vessel ID	Site ID	County	Before Temp	After Temp	Time Arrived	Time Departed	DO Before	DO After	2,4-D	Glyphosate	Imazamox	Penoxsulam	Agridex	Competitor	Chem Rate	2,4-D Acres	Glyphosate Acres	Imazamox Acres	Penoxsulam Acres	Wind Speed
5/1/2018	MERCED	412	Merced	15.40	16.90	900	1200	6.65	7.73	0.00	0.03	0.00	0.00	0.02	0.00	96	0.00	0.04	0.00	0.00	0-2
5/2/2018	3420	14	San Joaquin	19.10	19.30	730	1300	9.80	8.80	0.00	6.00	2.00	0.00	3.00	0.00	130	0.00	5.91	1.97	0.00	2-4
5/2/2018	9980	300	San Joaquin	15.80	16.00	830	1000	8.62	7.78	0.00	1.00	0.75	0.00	0.75	0.00	96	0.00	1.33	1.00	0.00	2-4
5/2/2018	9980	302	San Joaquin	16.30	16.40	1000	1230	7.34	8.45	0.00	1.00	0.75	0.00	0.50	0.00	96	0.00	1.33	1.00	0.00	2-4
5/2/2018	9980	304	San Joaquin	16.60	16.80	1300	1400	8.63	8.90	0.00	0.25	0.25	0.00	0.25	0.00	96	0.00	0.33	0.33	0.00	4-6
5/2/2018	MERCED	408	Merced	14.40	20.10	810	1300	6.23	6.80	0.00	0.11	0.00	0.00	0.05	0.00	96	0.00	0.15	0.00	0.00	4-6
5/3/2018	3420	65	San Joaquin	18.60	18.80	900	1130	9.20	9.00	0.00	2.50	0.00	0.00	1.25	0.00	130	0.00	2.46	0.00	0.00	2-4
5/3/2018	9123	91	Contra Costa	19.20	21.10	9	1030	8.40	8.20	0.00	2.50	0.00	0.00	1.25	0.00	120	0.00	2.67	0.00	0.00	2-4
5/3/2018	9123	92	San Joaquin	20.20	20.50	1030	1200	9.90	8.40	0.00	2.50	0.00	0.00	1.25	0.00	120	0.00	2.67	0.00	0.00	4-6
5/3/2018	MERCED	408	Merced	17.70	22.10	830	1300	5.47	6.35	0.00	0.08	0.00	0.00	0.04	0.00	96	0.00	0.11	0.00	0.00	2-4
5/4/2018	MERCED	520	Merced	18.90	24.60	800	1300	8.46	8.06	0.00	0.23	0.00	0.00	0.12	0.00	96	0.00	0.31	0.00	0.00	0-2
5/7/2018	3420	31	San Joaquin	19.40	19.60	1230	1500	9.30	8.00	0.00	5.50	0.00	0.00	3.00	0.00	130	0.00	5.42	0.00	0.00	4-6
5/7/2018	MERCED	407	Merced	20.00	23.70	900	1340	6.23	6.43	0.00	0.02	0.00	0.00	0.01	0.00	96	0.00	0.03	0.00	0.00	2-4
5/7/2018	MERCED	408	Merced	19.90	20.00	800	900	5.57	6.23	0.00	0.03	0.00	0.00	0.02	0.00	96	0.00	0.04	0.00	0.00	2-4
5/8/2018	3420	65	San Joaquin	19.70	19.50	1200	1500	9.60	8.60	0.00	7.50	0.00	0.00	4.00	0.00	130	0.00	7.38	0.00	0.00	4-6
5/8/2018	9980	301	San Joaquin	19.50	20.10	930	1235	9.26	8.14	0.00	0.00	0.75	0.00	0.50	0.00	96	0.00	0.00	1.00	0.00	2-4
5/8/2018	MERCED	402	Merced	21.50	25.40	940	1350	8.19	9.02	0.00	0.03	0.00	0.00	0.02	0.00	96	0.00	0.04	0.00	0.00	0-2
5/9/2018	MERCED	404	Merced	21.40	25.10	755	1240	7.79	8.53	0.00	0.03	0.00	0.00	0.02	0.00	96	0.00	0.04	0.00	0.00	0-2
5/9/2018	MERCED	405	Merced	21.10	24.30	1240	1400	6.61	7.06	0.00	0.03	0.00	0.00	0.02	0.00	96	0.00	0.04	0.00	0.00	2-4
5/10/2018	MERCED	520	Merced	18.20	22.30	740	1355	8.87	8.33	0.00	0.36	0.00	0.00	0.18	0.00	96	0.00	0.48	0.00	0.00	4-6
5/15/2018	8835	48	San Joaquin	17.20	18.00	930	1330	7.10	6.80	0.00	2.00	2.00	0.00	0.00	2.50	128	0.00	2.00	2.00	0.00	6-8
5/15/2018	MERCED	412	Merced	21.40	22.00	1235	1355	7.94	7.56	0.00	0.03	0.00	0.00	0.02	0.00	96	0.00	0.04	0.00	0.00	4-6
5/15/2018	MERCED	413	Merced	18.30	21.40	900	1235	7.71	7.94	0.00	0.06	0.00	0.00	0.03	0.00	96	0.00	0.08	0.00	0.00	4-6
5/16/2018	3420	9	San Joaquin	22.10	22.50	930	1400	8.50	7.20	0.00	2.50	0.00	0.00	1.50	0.00	130	0.00	2.46	0.00	0.00	2-4
5/16/2018	MERCED	410	Merced	19.20	21.20	1000	1330	7.39	7.65	0.00	0.03	0.00	0.00	0.02	0.00	96	0.00	0.04	0.00	0.00	0-2
5/16/2018	MERCED	412	Merced	18.30	19.20	830	1000	7.47	7.39	0.00	0.04	0.00	0.00	0.02	0.00	96	0.00	0.05	0.00	0.00	0-2
5/17/2018	3420	203	San Joaquin	18.70	21.40	900	1500	5.00	1.70	0.00	10.50	0.00	0.00	5.00	0.00	130	0.00	10.34	0.00	0.00	2-4
5/17/2018	3738	26	San Joaquin	23.00	22.80	900	1300	9.60	8.30	0.00	6.00	2.00	0.00	3.50	0.00	130	0.00	5.91	1.97	0.00	0-2
5/17/2018	9980	321	Stanislaus	19.80	19.90	900	1000	9.10	9.13	0.00	0.50	0.00	0.00	0.25	0.00	120	0.00	0.53	0.00	0.00	2-4
5/17/2018	9980	322	Stanislaus	20.20	20.10	1015	1130	9.13	9.45	0.00	1.00	0.00	0.00	0.50	0.00	120	0.00	1.07	0.00	0.00	2-4
5/17/2018	9980	323	Stanislaus	20.10	20.80	1130	1300	9.45	9.55	0.00	1.00	0.00	0.00	0.25	0.00	120	0.00	1.07	0.00	0.00	4-6
5/17/2018	MERCED	521	Merced	16.60	20.10	800	1300	0.89	1.18	0.00	0.39	0.00	0.00	0.20	0.00	97	0.00	0.51	0.00	0.00	4-6
5/18/2018	MERCED	409	Merced	22.20	25.80	1000	1300	6.39	6.07	0.00	0.06	0.00	0.00	0.03	0.00	96	0.00	0.08	0.00	0.00	2-4
5/18/2018	MERCED	410	Merced	19.60	22.20	800	1000	6.66	6.39	0.00	0.03	0.00	0.00	0.02	0.00	96	0.00	0.04	0.00	0.00	2-4
5/21/2018	MERCED	409	Merced	20.30	20.60	830	1300	6.13	6.40	0.00	0.09	0.00	0.00	0.05	0.00	96	0.00	0.12	0.00	0.00	4-6
5/22/2018	3420	14	San Joaquin	21.10	21.60	1230	1500	9.10	8.80	0.00	3.50	0.00	0.00	1.50	0.00	130	0.00	3.45	0.00	0.00	2-4
5/23/2018	3420	12	San Joaquin	19.80	21.50	900	1230	8.90	9.50	0.00	4.00	0.00	0.00	0.00	2.00	130	0.00	3.94	0.00	0.00	0-2
5/24/2018	3420	58	San Joaquin	21.50	21.80	1200	1430	8.80	9.10	0.00	2.50	0.00	0.00	1.25	0.00	130	0.00	2.46	0.00	0.00	4-6
5/24/2018	9123	92	Contra Costa	22.10	22.40	930	1300	9.30	7.90	0.00	5.00	0.00	0.00	2.50	0.00	120	0.00	5.33	0.00	0.00	2-4
5/29/2018	9980	520	Merced	22.30	24.70	845	1330	2.00	2.00	0.00	5.75	0.00	0.00	2.50	0.00	120	0.00	6.13	0.00	0.00	0-2
5/29/2018	MERCED	521	Merced	21.00	20.70	740	940	0.97	1.17	0.00	0.12	0.00	0.00	0.06	0.00	96	0.00	0.16	0.00	0.00	0-2
5/29/2018	MERCED	529	Merced	26.60	30.30	1030	1330	8.50	8.70	0.00	0.05	0.00	0.00	0.03	0.00	96	0.00	0.07	0.00	0.00	0-2
5/30/2018	MERCED	518	Merced	20.80	23.60	930	1330	8.69	9.76	0.00	0.05	0.00	0.00	0.03	0.00	96	0.00	0.07	0.00	0.00	0-2
5/30/2018	MERCED	519	Merced	19.00	20.80	740	930	8.59	8.69	0.00	0.02	0.00	0.00	0.01	0.00	96	0.00	0.03	0.00	0.00	0-2
5/31/2018	9980	300	San Joaquin	21.30	21.70	845	1100	7.42	7.55	0.00	0.00	0.50	0.00	0.25	0.00	96	0.00	0.00	0.67	0.00	2-4
5/31/2018	9980	302	San Joaquin	22.00	23.40	1145	1400	7.84	8.15	0.00	0.00	0.50	0.00	0.25	0.00	96	0.00	0.00	0.67	0.00	2-4
										0.00	74.92	9.50	0.00	36.02	4.50		0.00	76.74	10.61	0.00	

Table B-4. June 2018 Herbicide and Adjuvant Use

Date	Vessel ID	Site ID	County	Before Temp	After Temp	Time Arrived	Time Departed	DO Before	DO After	2,4-D	Glyphosate	Imazamox	Penoxsulam	Agridex	Competitor	Chem Rate	2,4-D Acres	Glyphosate Acres	Imazamox Acres	Penoxsulam Acres	Wind Speed
6/4/2018	MERCED	408	Merced	24.20	29.80	750	1300	6.08	5.60	0.00	0.08	0.00	0.00	0.04	0.00	96	0.00	0.11	0.00	0.00	0-2
6/6/2018	3420	58	San Joaquin	21.50	22.30	1030	1400	9.10	8.60	0.00	2.50	0.00	0.00	0.00	1.25	130	0.00	2.46	0.00	0.00	2-4
6/6/2018	9980	313	Stanislaus	21.40	22.20	1000	1400	9.20	8.88	0.00	0.75	0.00	0.00	0.25	0.00	120	0.00	0.80	0.00	0.00	2-4
6/6/2018	MERCED	408	Merced	21.20	23.90	730	1230	5.86	6.35	0.00	0.09	0.00	0.00	0.05	0.00	96	0.00	0.12	0.00	0.00	0-2
6/7/2018	9123	110	Contra Costa	22.10	22.50	1030	1500	8.30	9.20	0.00	7.50	0.00	0.00	3.00	0.00	130	0.00	7.38	0.00	0.00	2-4
6/7/2018	MERCED	404	Merced	22.70	25.80	1150	1300	8.18	8.29	0.00	0.02	0.00	0.00	0.01	0.00	96	0.00	0.03	0.00	0.00	2-4
6/7/2018	MERCED	405	Merced	21.70	22.70	940	1150	7.64	8.18	0.00	0.03	0.00	0.00	0.02	0.00	96	0.00	0.04	0.00	0.00	0-2
6/7/2018	MERCED	407	Merced	20.10	21.70	730	940	6.48	7.64	0.00	0.05	0.00	0.00	0.02	0.00	96	0.00	0.07	0.00	0.00	0-2
6/8/2018	MERCED	412	Merced	22.00	35.50	940	1230	8.48	7.05	0.00	0.03	0.00	0.00	0.02	0.00	96	0.00	0.04	0.00	0.00	2-4
6/8/2018	MERCED	413	Merced	18.80	22.00	730	940	7.87	8.48	0.00	0.06	0.00	0.00	0.03	0.00	96	0.00	0.08	0.00	0.00	0-2
6/11/2018	FRESNO	909	Fresno	22.50	20.50	845	1200	7.80	8.10	0.00	0.00	0.00	0.00	0.15	0.00	256	0.00	0.00	0.00	0.00	2-4
6/11/2018	MERCED	411	Merced	18.90	20.80	740	1100	7.19	7.62	0.00	0.03	0.00	0.00	0.02	0.00	96	0.00	0.04	0.00	0.00	0-2
6/11/2018	MERCED	412	Merced	20.90	23.90	1100	1230	7.62	6.93	0.00	0.02	0.00	0.00	0.01	0.00	96	0.00	0.03	0.00	0.00	4-6
6/12/2018	9980	303	San Joaquin	23.30	24.70	800	1400	7.82	7.25	0.00	2.00	2.00	0.00	1.00	0.00	96	0.00	2.67	2.67	0.00	0-2
6/12/2018	FRESNO	909	Fresno	22.50	24.60	830	1130	7.61	7.65	0.00	0.61	0.00	0.00	0.15	0.00	256	0.00	0.31	0.00	0.00	0
6/12/2018	MERCED	409	Merced	24.80	23.80	1040	1330	6.08	6.34	0.00	0.02	0.00	0.00	0.01	0.00	96	0.00	0.03	0.00	0.00	2-4
6/12/2018	MERCED	410	Merced	21.50	24.80	730	1040	6.05	6.08	0.00	0.03	0.00	0.00	0.02	0.00	96	0.00	0.04	0.00	0.00	0-2
6/13/2018	FRESNO	909	Fresno	23.50	23.30	830	1140	8.80	7.70	0.00	0.00	0.00	0.00	0.15	0.00	256	0.00	0.00	0.00	0.00	0
6/13/2018	MERCED	409	Merced	25.70	34.30	930	1300	5.47	5.30	0.00	0.06	0.00	0.00	0.03	0.00	96	0.00	0.08	0.00	0.00	2-4
6/13/2018	MERCED	410	Merced	23.60	25.70	730	930	5.57	5.47	0.00	0.02	0.00	0.00	0.01	0.00	96	0.00	0.03	0.00	0.00	2-4
6/14/2018	0800	28	San Joaquin	24.60	24.30	900	1300	7.70	8.10	0.00	7.50	1.00	0.00	4.25	0.00	160	0.00	6.00	0.80	0.00	0-2
6/14/2018	9011	20	Sacramento	22.80	26.10	930	1400	8.00	5.90	0.00	7.50	0.00	0.00	3.75	0.00	128	0.00	7.50	0.00	0.00	6-8
6/14/2018	FRESNO	910	Fresno	23.00	23.00	756	12	7.50	7.00	0.00	0.61	0.00	0.00	0.15	0.00	256	0.00	0.31	0.00	0.00	0
6/14/2018	MERCED	409	Merced	23.40	28.30	720	1250	6.16	5.41	0.00	0.11	0.00	0.00	0.05	0.00	96	0.00	0.15	0.00	0.00	2-4
6/15/2018	FRESNO	910	Fresno	23.60	24.00	907	1144	7.53	8.65	0.00	2.30	0.00	0.00	0.10	0.00	256	0.00	1.15	0.00	0.00	0
6/18/2018	9980	300	San Joaquin	22.80	23.10	930	1100	7.47	7.95	0.00	0.00	1.00	0.00	0.50	0.00	96	0.00	0.00	1.33	0.00	2-4
6/18/2018	9980	301	San Joaquin	23.70	24.20	1100	1230	7.22	7.07	0.00	0.00	1.00	0.00	0.50	0.00	96	0.00	0.00	1.33	0.00	4-6
6/18/2018	9980	304	San Joaquin	24.10	24.30	1300	1530	5.19	7.88	0.00	2.50	0.00	0.00	0.00	0.00	96	0.00	3.33	0.00	0.00	4-6
6/18/2018	MERCED	408	Merced	20.10	24.50	740	1250	5.60	7.09	0.00	0.05	0.00	0.00	0.02	0.00	96	0.00	0.07	0.00	0.00	0-2
6/19/2018	9980	302	San Joaquin	24.40	24.50	830	1000	7.22	7.55	64.00	0.00	0.00	0.00	0.25	0.00	64	64.00	0.00	0.00	0.00	2-4
6/19/2018	9980	303	San Joaquin	24.80	24.90	1015	1230	7.80	7.90	64.00	0.00	0.00	0.00	0.25	0.00	64	64.00	0.00	0.00	0.00	2-4
6/19/2018	MERCED	408	Sacramento	21.70	25.60	730	1240	6.32	6.26	0.00	0.08	0.00	0.00	0.04	0.00	0	0.00	0.00	0.00	0.00	0-2
6/20/2018	3420	32	San Joaquin	23.50	23.70	830	1030	8.60	8.40	0.00	1.50	0.00	0.00	0.75	0.00	130	0.00	1.48	0.00	0.00	0-2
6/20/2018	3420	34	San Joaquin	23.20	23.40	730	830	8.20	8.60	0.00	1.00	0.00	0.00	0.50	0.00	130	0.00	0.98	0.00	0.00	0-2
6/21/2018	3420	58	San Joaquin	23.70	24.20	1200	1400	9.40	9.10	0.00	5.00	0.00	0.00	2.50	0.00	130	0.00	4.92	0.00	0.00	0-2
6/21/2018	9011	253	Sacramento	21.30	21.00	930	1000	8.20	8.40	0.00	0.75	0.00	0.00	0.50	0.00	255	0.00	0.38	0.00	0.00	6-8
6/21/2018	9011	259	Yolo	21.70	24.00	1130	1200	8.50	8.20	0.00	0.50	0.00	0.00	0.50	0.00	255	0.00	0.25	0.00	0.00	0-2
6/21/2018	9011	265	Solano	21.40	22.10	1030	1100	8.70	8.00	0.00	0.50	0.00	0.00	0.50	0.00	255	0.00	0.25	0.00	0.00	4-6
6/21/2018	9980	49	San Joaquin	23.00	23.20	930	1430	7.80	6.20	0.00	5.00	0.00	0.00	0.00	2.50	128	0.00	5.00	0.00	0.00	6-8
6/21/2018	MERCED	400	Merced	23.10	26.60	740	1240	7.82	9.69	0.00	0.00	0.00	0.00	0.00	0.00	96	0.00	0.00	0.00	0.00	2-4
6/21/2018	MERCED	401	Merced	23.70	25.60	900	1145	8.14	9.10	0.00	0.02	0.00	0.00	0.01	0.00	96	0.00	0.03	0.00	0.00	4-6
6/22/2018	8890	77	San Joaquin	23.80	24.00	1000	1400	6.25	7.18	0.00	0.00	3.50	0.00	0.00	2.50	256	0.00	0.00	1.75	0.00	6-8
6/22/2018	9011	20	Sacramento	22.90	27.30	900	1530	7.10	6.90	0.00	15.75	0.00	0.00	7.50	0.00	256	0.00	7.88	0.00	0.00	4-6
6/22/2018	9123	101	Contra Costa	23.70	24.20	1130	1400	7.09	7.13	2.50	0.00	0.00	0.00	1.25	0.00	128	1.25	0.00	0.00	0.00	0-2
6/22/2018	9123	101	San Joaquin	23.10	24.00	830	1100	6.91	7.33	5.00	0.00	0.00	0.00	2.50	0.00	128	2.50	0.00	0.00	0.00	0-2
6/25/2018	3420	12	San Joaquin	25.50	25.70	1200	1430	7.50	8.10	0.00	2.50	0.00	0.00	1.25	0.00	130	0.00	2.46	0.00	0.00	2-4
6/25/2018	MERCED	512	Merced	25.50	27.60	940	1320	9.04	9.26	0.00	0.01	0.00	0.00	0.01	0.00	96	0.00	0.01	0.00	0.00	2-4
6/25/2018	MERCED	513	Merced	23.90	25.50	740	940	8.06	9.04	0.00	0.02	0.00	0.00	0.01	0.00	96	0.00	0.03	0.00	0.00	2-4
6/26/2018	MERCED	511	Merced	22.40	28.20	700	1345	9.27	8.97	0.00	0.06	0.00	0.00	0.03	0.00	96	0.00	0.08	0.00	0.00	0-2

Date	Vessel ID	Site ID	County	Before Temp	After Temp	Time Arrived	Time Departed	DO Before	DO After	2,4-D	Glyphosate	Imazamox	Penoxsulam	Agridex	Competitor	Chem Rate	2,4-D Acres	Glyphosate Acres	Imazamox Acres	Penoxsulam Acres	Wind Speed
6/27/2018	3420	99	Contra Costa	25.60	25.80	900	1100	8.30	9.10	0.00	3.75	0.00	0.00	1.75	0.00	260	0.00	1.85	0.00	0.00	0-2
6/27/2018	3420	99	San Joaquin	25.80	26.10	1200	1400	9.20	9.00	0.00	3.75	0.00	0.00	1.75	0.00	260	0.00	1.85	0.00	0.00	4-6
6/27/2018	9980	48	San Joaquin	24.00	23.80	1230	1500	5.90	7.60	0.00	0.00	5.00	0.00	0.00	2.50	175	0.00	0.00	3.66	0.00	4-6
6/27/2018	9980	49	San Joaquin	23.10	22.90	930	1200	6.20	5.90	0.00	2.50	0.00	0.00	1.25	0.00	175	0.00	1.83	0.00	0.00	4-6
6/27/2018	9980	291	San Joaquin	21.90	22.90	930	1400	7.70	6.80	0.00	0.00	5.00	0.00	0.00	2.50	175	0.00	0.00	3.66	0.00	6-8
6/27/2018	MERCED	508	Merced	30.00	31.10	1230	1300	8.44	8.25	0.00	0.01	0.00	0.00	0.01	0.00	96	0.00	0.01	0.00	0.00	0-2
6/27/2018	MERCED	509	Merced	27.40	30.00	1120	1230	8.19	8.44	0.00	0.02	0.00	0.00	0.01	0.00	96	0.00	0.03	0.00	0.00	0-2
6/27/2018	MERCED	510	Merced	24.60	27.40	800	1120	8.25	8.19	0.00	0.03	0.00	0.00	0.02	0.00	96	0.00	0.04	0.00	0.00	0-2
6/28/2018	3420	8	San Joaquin	26.10	25.80	1200	1300	8.50	9.10	0.00	0.50	0.00	0.00	0.25	0.00	260	0.00	0.25	0.00	0.00	0-2
6/28/2018	3420	9	San Joaquin	25.40	25.60	900	1200	8.20	8.70	0.00	4.50	0.00	0.00	2.00	0.00	260	0.00	2.22	0.00	0.00	0-2
6/28/2018	9011	20	Sacramento	22.40	22.50	1000	1300	6.70	6.50	0.00	9.00	0.00	0.00	6.00	0.00	256	0.00	4.50	0.00	0.00	6-8
6/28/2018	9123	101	Contra Costa	22.90	23.40	1000	1200	7.20	7.80	5.00	0.00	0.00	0.00	2.50	0.00	128	2.50	0.00	0.00	0.00	4-6
6/28/2018	9980	76	San Joaquin	23.10	23.60	800	1130	6.20	6.10	0.00	0.00	7.00	0.00	0.00	3.50	192	0.00	0.00	4.67	0.00	6-8
6/28/2018	9980	77	San Joaquin	24.00	23.90	1230	1530	7.20	7.00	0.00	2.50	0.00	0.00	1.25	0.00	192	0.00	1.67	0.00	0.00	6-8
6/28/2018	MERCED	529	Merced	17.70	23.00	720	1240	9.19	9.81	0.00	0.11	0.00	0.00	0.05	0.00	96	0.00	0.15	0.00	0.00	0-2
6/29/2018	9011	20	Sacramento	22.80	29.40	900	1500	7.30	6.10	0.00	12.25	0.00	0.00	3.75	0.00	256	0.00	6.13	0.00	0.00	4-6
										140.50	106.08	25.50	0.00	53.25	14.75		134.25	77.09	19.86	0.00	

Table B-5. July 2018 Herbicide and Adjuvant Use

Date	Vessel ID	Site ID	County	Before Temp	After Temp	Time Arrived	Time Departed	DO Before	DO After	2,4-D	Glyphosate	Imazamox	Penoxsulam	Agridex	Competitor	Chem Rate	2,4-D Acres	Glyphosate Acres	Imazamox Acres	Penoxsulam Acres	Wind Speed
7/2/2018	MERCED	506	Merced	27.60	28.00	1200	1330	8.74	8.35	0.00	0.02	0.00	0.00	0.01	0.00	96	0.00	0.03	0.00	0.00	4-6
7/2/2018	MERCED	507	Merced	26.70	27.60	1000	1220	7.93	8.74	0.00	0.01	0.00	0.00	0.01	0.00	96	0.00	0.01	0.00	0.00	2-4
7/2/2018	MERCED	508	Merced	26.30	26.70	800	1000	7.45	1.93	0.00	0.03	0.00	0.00	0.02	0.00	96	0.00	0.04	0.00	0.00	2-4
7/3/2018	3420	6	San Joaquin	25.10	24.50	900	1400	7.20	8.30	0.00	10.00	0.00	0.00	6.00	0.00	260	0.00	4.92	0.00	0.00	0-2
7/3/2018	MERCED	412	Merced	23.70	27.60	1100	1140	6.86	6.58	0.00	0.06	0.00	0.00	0.03	0.00	96	0.00	0.08	0.00	0.00	2-4
7/3/2018	MERCED	413	Merced	23.10	23.70	750	1100	7.46	6.86	0.00	0.08	0.00	0.00	0.04	0.00	96	0.00	0.11	0.00	0.00	0-2
7/5/2018	MERCED	410	Merced	21.90	25.80	840	1230	5.89	5.89	0.00	0.03	0.00	0.00	0.02	0.00	96	0.00	0.04	0.00	0.00	4-6
7/5/2018	MERCED	412	Merced	22.00	21.90	720	840	5.89	5.89	0.00	0.03	0.00	0.00	0.02	0.00	96	0.00	0.04	0.00	0.00	0-2
7/6/2018	MERCED	409	Merced	24.80	28.30	740	1240	5.59	5.91	0.00	0.09	0.00	0.00	0.05	0.00	96	0.00	0.12	0.00	0.00	0-2
7/9/2018	3420	68	San Joaquin	23.50	23.80	930	1330	7.30	8.50	0.00	2.50	0.00	0.00	1.50	0.00	260	0.00	1.23	0.00	0.00	4-6
7/9/2018	3548	26	San Joaquin	25.90	26.50	930	1230	7.10	7.40	0.00	7.50	0.00	0.00	3.00	0.00	130	0.00	7.38	0.00	0.00	2-4
7/9/2018	9339	128	Sacramento	23.00	23.20	930	1230	8.00	8.20	5.00	0.00	0.00	0.00	2.50	0.00	128	2.50	0.00	0.00	0.00	6-8
7/10/2018	0080	39	San Joaquin	26.00	28.80	1330	1530	8.80	7.60	1.50	0.00	0.00	0.00	0.75	0.00	128	0.75	0.00	0.00	0.00	0-2
7/10/2018	0080	40	San Joaquin	26.00	26.10	1000	1330	9.10	8.70	2.50	0.50	0.00	0.00	2.75	0.00	128	1.25	0.50	0.00	0.00	0-2
7/10/2018	3420	7	San Joaquin	23.80	23.70	1100	1500	9.00	8.60	0.00	5.00	0.00	0.00	2.50	0.00	260	0.00	2.46	0.00	0.00	2-4
7/10/2018	3420	8	San Joaquin	23.60	23.70	800	1030	9.10	9.30	0.00	2.50	0.00	0.00	1.50	0.00	260	0.00	1.23	0.00	0.00	2-4
7/10/2018	9980	48	San Joaquin	26.80	29.70	930	1200	7.24	7.52	0.00	0.00	2.00	0.00	1.00	0.00	120	0.00	0.00	2.13	0.00	2-4
7/11/2018	0025	39	San Joaquin	26.80	27.00	930	1300	12.90	12.20	0.00	4.00	0.00	0.00	2.00	0.00	100	0.00	5.12	0.00	0.00	2-4
7/11/2018	0080	26	San Joaquin	26.00	26.80	700	1100	9.10	8.50	2.50	0.00	0.00	0.00	1.25	0.00	200	0.80	0.00	0.00	0.00	0-2
7/11/2018	0080	34	San Joaquin	27.30	27.10	1100	1430	8.80	7.90	2.50	0.00	0.00	0.00	1.25	0.00	200	0.80	0.00	0.00	0.00	2-4
7/11/2018	3548	278	Solano	23.30	26.50	900	1230	7.50	7.40	0.00	10.00	0.00	0.00	5.00	0.00	260	0.00	4.92	0.00	0.00	2-4
7/11/2018	8835	74	San Joaquin	21.10	22.00	830	1507	9.04	6.70	0.00	0.00	7.00	0.00	0.00	3.50	192	0.00	0.00	4.67	0.00	2-4
7/11/2018	9123	79	Alameda	26.00	26.90	1300	1400	7.40	7.70	0.00	1.00	0.00	0.00	0.50	0.00	240	0.00	0.53	0.00	0.00	0-2
7/11/2018	9339	124	Sacramento	23.90	24.20	1100	1330	8.30	8.60	5.00	0.00	0.00	0.00	2.50	0.00	200	1.60	0.00	0.00	0.00	4-6
7/11/2018	9339	126	Sacramento	23.30	23.80	900	1100	8.70	8.90	5.00	0.00	0.00	0.00	2.50	0.00	200	1.60	0.00	0.00	0.00	4-6
7/11/2018	9980	48	San Joaquin	26.80	29.70	930	1200	7.24	7.52	2.00	0.00	0.00	0.00	1.00	0.00	64	2.00	0.00	0.00	0.00	2-4
7/11/2018	9980	291	San Joaquin	27.10	29.70	830	1300	7.10	7.30	6.50	0.00	0.00	0.00	3.25	0.00	64	6.50	0.00	0.00	0.00	2-4
7/11/2018	MERCED	409	Merced	24.60	28.90	840	1320	6.04	5.16	0.00	0.13	0.00	0.00	0.06	0.00	96	0.00	0.17	0.00	0.00	2-4
7/12/2018	0080	32	San Joaquin	27.40	27.60	1230	1530	9.10	7.90	4.00	0.00	0.00	0.00	2.00	0.00	128	2.00	0.00	0.00	0.00	0-2
7/12/2018	3420	13	San Joaquin	25.70	26.10	800	1400	8.40	9.10	0.00	10.00	0.00	0.00	5.25	0.00	260	0.00	4.92	0.00	0.00	0-2
7/12/2018	8834	252	Sacramento	22.50	22.20	830	930	7.80	7.60	0.00	5.00	0.00	0.00	2.50	0.00	240	0.00	2.67	0.00	0.00	4-6
7/12/2018	8835	74	San Joaquin	27.10	26.70	900	1500	6.80	6.10	0.00	0.00	7.00	0.00	0.00	3.50	196	0.00	0.00	4.57	0.00	2-4
7/12/2018	9980	74	San Joaquin	27.50	29.80	830	1400	7.44	7.13	0.00	5.00	0.00	0.00	2.50	0.00	120	0.00	5.33	0.00	0.00	2-4
7/12/2018	MERCED	408	Merced	24.70	28.40	720	1240	5.33	6.24	0.00	0.13	0.00	0.00	0.06	0.00	96	0.00	0.17	0.00	0.00	0-2
7/13/2018	0006	212	Sacramento	22.40	23.00	800	1430	7.40	6.90	0.00	9.00	0.00	0.00	5.00	0.00	162	0.00	7.11	0.00	0.00	2-4
7/13/2018	0080	26	San Joaquin	27.10	28.60	800	1300	9.60	8.10	2.50	0.00	0.00	0.00	1.25	0.00	128	1.25	0.00	0.00	0.00	0-2
7/13/2018	0080	36	San Joaquin	28.30	22.10	1400	1500	10.40	9.30	0.00	2.50	0.00	0.00	1.25	0.00	128	0.00	2.50	0.00	0.00	2-4
7/13/2018	0080	37	San Joaquin	28.00	28.10	1500	1600	8.80	9.40	0.00	2.50	0.00	0.00	1.25	0.00	128	0.00	2.50	0.00	0.00	6-8
7/13/2018	9607	127	Sacramento	23.90	23.70	800	1100	8.10	7.90	5.00	0.00	0.00	0.00	2.50	0.00	200	1.60	0.00	0.00	0.00	4-6
7/13/2018	9607	128	Sacramento	23.80	23.90	1100	1400	8.00	8.40	5.00	0.00	0.00	0.00	2.50	0.00	200	1.60	0.00	0.00	0.00	4-6
7/13/2018	MERCED	408	Merced	25.50	28.00	720	1300	6.14	6.23	0.00	0.13	0.00	0.00	0.06	0.00	96	0.00	0.17	0.00	0.00	0-2
7/16/2018	3420	6	San Joaquin	26.50	27.10	800	1400	9.10	9.40	0.00	11.50	0.00	0.00	5.00	0.00	260	0.00	5.66	0.00	0.00	0-2
7/16/2018	9011	217	Sacramento	23.50	27.10	1031	1510	1.10	11.10	0.00	8.00	0.00	0.00	1.75	0.00	256	0.00	4.00	0.00	0.00	4-6
7/16/2018	9607	126	Sacramento	23.80	23.60	800	1100	8.10	8.00	2.50	0.00	0.00	0.00	1.25	0.00	200	0.80	0.00	0.00	0.00	6-8
7/16/2018	9607	128	Sacramento	8.00	23.90	1100	1400	8.00	8.30	7.50	0.00	0.00	0.00	3.00	0.00	200	2.40	0.00	0.00	0.00	6-8
7/16/2018	9980	300	San Joaquin	27.80	29.10	800	1100	7.10	7.22	0.00	0.00	0.00	0.00	1.25	0.00	64	0.00	0.00	0.00	0.00	2-4
7/16/2018	9980	303	San Joaquin	24.00	30.10	1130	1400	7.40	7.55	0.00	0.00	0.00	0.00	1.25	0.00	64	0.00	0.00	0.00	0.00	2-4
7/16/2018	MERCED	404	Merced	28.10	28.60	1210	1315	9.68	9.57	0.02	0.00	0.00	0.00	0.01	0.00	96	0.01	0.00	0.00	0.00	2-4
7/16/2018	MERCED	405	Merced	26.10	28.10	1000	1210	8.18	9.68	0.02	0.00	0.00	0.00	0.01	0.00	96	0.01	0.00	0.00	0.00	4-6
7/16/2018	MERCED	407	Merced	25.10	26.10	800	1000	6.07	8.18	0.03	0.00	0.00	0.00	0.02	0.00	96	0.02	0.00	0.00	0.00	4-6

Date	Vessel ID	Site ID	County	Before Temp	After Temp	Time Arrived	Time Departed	DO Before	DO After	2,4-D	Glyphosate	Imazamox	Penoxsulam	Agridex	Competitor	Chem Rate	2,4-D Acres	Glyphosate Acres	Imazamox Acres	Penoxsulam Acres	Wind Speed
7/17/2018	0080	26	San Joaquin	28.00	28.10	700	1430	9.10	7.90	4.50	0.00	0.00	0.00	2.25	0.00	128	2.25	0.00	0.00	0.00	0-2
7/17/2018	3420	6	San Joaquin	26.30	27.30	800	1400	9.00	8.60	0.00	12.50	0.00	0.00	6.00	0.00	260	0.00	6.15	0.00	0.00	0-2
7/17/2018	3548	203	San Joaquin	22.30	26.10	830	1300	7.60	7.20	0.00	12.50	0.00	0.00	6.00	0.00	200	0.00	8.00	0.00	0.00	2-4
7/17/2018	8834	262	Solano	23.40	24.20	1000	1330	7.50	6.80	0.00	7.50	0.00	0.00	4.50	0.00	240	0.00	4.00	0.00	0.00	6-8
7/17/2018	9011	216	Sacramento	24.20	26.10	958	1505	10.10	11.10	0.00	8.50	0.00	0.00	4.75	0.00	256	0.00	4.25	0.00	0.00	2-4
7/17/2018	9980	706	Stanislaus	26.80	27.30	930	1130	9.45	9.80	0.00	0.50	0.00	0.00	0.25	0.00	120	0.00	0.53	0.00	0.00	2-4
7/17/2018	9980	707	Stanislaus	27.30	29.40	1200	1400	9.80	9.55	0.00	0.75	0.00	0.00	0.50	0.00	120	0.00	0.80	0.00	0.00	2-4
7/18/2018	3420	65	San Joaquin	26.50	27.10	830	1400	8.30	8.90	0.00	12.50	0.00	0.00	6.00	0.00	260	0.00	6.15	0.00	0.00	2-4
7/18/2018	3548	205	San Joaquin	23.00	25.80	930	1230	7.10	7.90	0.00	10.00	0.00	0.00	5.00	0.00	200	0.00	6.40	0.00	0.00	0-2
7/18/2018	8834	176	Sacramento	22.00	22.50	900	1230	8.00	7.40	7.50	0.00	0.00	0.00	5.00	0.00	120	4.00	0.00	0.00	0.00	6-8
7/18/2018	8835	74	San Joaquin	23.00	23.80	930	1400	5.10	5.20	0.00	7.50	4.00	0.00	3.75	2.50	128	0.00	7.50	4.00	0.00	4-6
7/18/2018	9011	286	Sacramento	24.90	24.90	1030	1114	7.40	7.40	0.00	1.25	0.00	0.00	0.50	0.00	256	0.00	0.63	0.00	0.00	0-2
7/18/2018	9123	850	Solano	23.60	23.80	1000	1130	8.20	8.10	0.25	0.00	0.00	0.00	0.14	0.00	200	0.08	0.00	0.00	0.00	6-8
7/18/2018	FRESNO	910	Fresno	24.00	24.00	947	1100	8.10	8.90	0.00	2.50	0.00	0.00	0.06	0.00	256	0.00	1.25	0.00	0.00	2-4
7/18/2018	MERCED	528	Merced	13.50	18.20	730	1230	11.18	11.39	0.00	0.06	0.00	0.00	0.03	0.00	96	0.00	0.08	0.00	0.00	0-2
7/19/2018	3420	13	San Joaquin	26.10	27.20	830	1430	8.10	9.30	0.00	8.50	0.00	0.00	4.25	0.00	260	0.00	4.18	0.00	0.00	2-4
7/19/2018	3548	214	San Joaquin	22.40	25.60	930	1330	8.20	8.40	0.00	12.50	0.00	0.00	6.00	0.00	200	0.00	8.00	0.00	0.00	0-2
7/19/2018	8834	262	Solano	22.90	24.90	1000	1500	9.20	2.10	0.00	5.00	0.00	0.00	3.00	0.00	240	0.00	2.67	0.00	0.00	6-8
7/19/2018	9011	203	San Joaquin	25.50	28.50	1015	1449	8.00	7.30	0.00	13.00	0.00	0.00	5.00	0.00	256	0.00	6.50	0.00	0.00	6-8
7/19/2018	9123	57	San Joaquin	25.30	26.10	930	13	8.60	8.10	7.50	0.00	0.00	0.00	0.00	0.00	128	3.75	0.00	0.00	0.00	2-4
7/19/2018	9980	713	Stanislaus	22.10	23.20	930	1330	10.14	10.55	0.00	1.25	0.00	0.00	0.75	0.00	192	0.00	0.83	0.00	0.00	2-4
7/19/2018	MERCED	522	Merced	20.70	24.20	1030	1320	10.54	11.99	0.03	0.00	0.00	0.00	0.02	0.00	96	0.02	0.00	0.00	0.00	0-2
7/19/2018	MERCED	523	Merced	18.80	20.70	815	1030	9.48	10.54	0.03	0.00	0.00	0.00	0.02	0.00	96	0.02	0.00	0.00	0.00	0-2
7/19/2018	MERCED	524	Merced	18.40	18.80	730	815	9.20	9.48	0.01	0.00	0.00	0.00	0.01	0.00	96	0.01	0.00	0.00	0.00	0-2
7/20/2018	9011	262	Solano	22.70	23.20	923	1155	1.70	1.70	0.00	6.00	0.00	0.00	2.25	0.00	256	0.00	3.00	0.00	0.00	8-10
7/20/2018	9980	215	San Joaquin	23.30	24.60	830	1200	8.40	7.50	0.00	7.50	0.00	0.00	4.00	0.00	200	0.00	4.80	0.00	0.00	2-4
7/23/2018	3420	61	San Joaquin	26.60	26.80	1200	1500	8.50	8.80	0.00	5.00	0.00	0.00	2.50	0.00	260	0.00	2.46	0.00	0.00	2-4
7/23/2018	3420	62	San Joaquin	26.20	26.30	900	1100	8.10	7.60	0.00	5.00	0.00	0.00	2.50	0.00	260	0.00	2.46	0.00	0.00	0-2
7/23/2018	8834	252	Sacramento	14.20	14.40	1000	1030	7.90	7.40	0.00	1.00	0.00	0.00	0.50	0.00	240	0.00	0.53	0.00	0.00	2-4
7/23/2018	8834	267	Solano	25.20	24.40	1200	1430	11.30	10.20	0.00	8.00	0.00	0.00	3.50	0.00	240	0.00	4.27	0.00	0.00	4-6
7/23/2018	8835	76	San Joaquin	26.20	27.00	900	1430	5.60	6.00	0.00	12.50	0.00	0.00	6.00	0.00	176	0.00	9.09	0.00	0.00	6-8
7/23/2018	9011	20	Sacramento	23.50	23.60	930	1500	5.50	6.80	0.00	8.25	0.00	0.00	3.00	0.00	256	0.00	4.13	0.00	0.00	8-10
7/23/2018	9123	57	San Joaquin	25.00	25.90	900	1100	6.20	7.30	1.50	0.00	0.00	0.00	0.75	0.00	128	0.75	0.00	0.00	0.00	0-2
7/23/2018	9339	112	Contra Costa	23.30	23.80	900	1200	7.90	8.10	4.00	0.00	0.00	0.00	2.00	0.00	128	2.00	0.00	0.00	0.00	4-6
7/23/2018	9607	0	Contra Costa	23.30	23.80	900	1200	7.90	8.10	5.00	0.00	0.00	0.00	2.50	0.00	200	1.60	0.00	0.00	0.00	4-6
7/23/2018	9980	301	San Joaquin	26.90	27.80	900	1300	7.11	7.23	1.00	0.00	0.00	0.00	0.50	0.00	141	0.45	0.00	0.00	0.00	2-4
7/23/2018	MERCED	519	Merced	25.50	26.60	1200	1305	9.25	9.17	0.00	0.02	0.00	0.00	0.01	0.00	0	0.00	0.00	0.00	0.00	4-6
7/23/2018	MERCED	520	Merced	22.60	25.50	940	1200	8.50	9.25	0.00	0.03	0.00	0.00	0.02	0.00	0	0.00	0.00	0.00	0.00	4-6
7/23/2018	MERCED	521	Merced	19.80	22.60	800	940	9.66	8.50	0.00	0.02	0.00	0.00	0.01	0.00	0	0.00	0.00	0.00	0.00	0-2
7/24/2018	3420	12	San Joaquin	27.30	27.50	1200	1500	8.60	9.20	0.00	4.00	1.00	0.00	0.00	2.50	260	0.00	1.97	0.49	0.00	2-4
7/24/2018	3420	61	San Joaquin	26.30	26.70	800	1100	8.50	8.80	0.00	5.00	0.00	0.00	2.50	0.00	260	0.00	2.46	0.00	0.00	0-2
7/24/2018	3548	215	Sacramento	24.30	26.80	830	1300	7.20	7.00	0.00	10.00	0.00	0.00	5.00	0.00	200	0.00	6.40	0.00	0.00	0-2
7/24/2018	9607	127	Sacramento	23.70	23.70	900	1000	8.40	8.80	2.50	0.00	0.00	0.00	1.25	0.00	200	0.80	0.00	0.00	0.00	6-8
7/24/2018	9607	130	Sacramento	24.00	24.10	1000	1200	7.80	8.10	5.00	0.00	0.00	0.00	2.50	0.00	200	1.60	0.00	0.00	0.00	6-8
7/24/2018	MERCED	520	Merced	22.60	30.30	700	1305	2.53	3.42	0.00	0.25	0.00	0.00	0.13	0.00	96	0.00	0.33	0.00	0.00	0-2
7/25/2018	0080	42	San Joaquin	27.90	27.90	1000	1530	8.60	11.30	5.00	0.00	0.00	0.00	2.50	0.00	128	2.50	0.00	0.00	0.00	2-4
7/25/2018	3420	15	San Joaquin	26.10	27.30	830	1400	8.50	7.10	0.00	9.00	1.00	0.00	5.00	0.00	260	0.00	4.43	0.49	0.00	2-4
7/25/2018	8834	270	Solano	23.70	23.80	1000	1100	8.40	8.20	0.00	2.50	0.00	0.00	1.00	0.00	240	0.00	1.33	0.00	0.00	4-6
7/25/2018	8835	76	San Joaquin	26.10	26.80	900	1400	5.20	5.10	0.00	0.00	8.00	0.00	0.00	4.00	192	0.00	0.00	5.33	0.00	4-6
7/25/2018	9011	202	San Joaquin	25.80	26.40	1340	1518	10.20	10.60	0.00	4.50	0.00	0.00	2.00	0.00	256	0.00	2.25	0.00	0.00	8-10
7/25/2018	9011	286	Sacramento	24.30	24.70	1117	1210	7.70	7.60	0.00	1.50	0.00	0.00	0.75	0.00	256	0.00	0.75	0.00	0.00	0-2
7/25/2018	FRESNO	910	Fresno	26.60	28.50	800	1030	6.90	7.12	0.00	10.00	0.00	0.00	0.13	0.00	256	0.00	5.00	0.00	0.00	2-4
7/25/2018	MERCED	412	Merced	26.10	28.70	1105	1340	6.20	6.80	0.03	0.00	0.00	0.00	0.02	0.00	96	0.02	0.00	0.00	0.00	2-4
7/25/2018	MERCED	413	Merced	25.50	26.10	800	1105	6.45	6.20	0.04	0.00	0.00	0.00	0.02	0.00	96	0.03	0.00	0.00	0.00	0-2

Date	Vessel ID	Site ID	County	Before Temp	After Temp	Time Arrived	Time Departed	DO Before	DO After	2,4-D	Glyphosate	Imazamox	Penoxsulam	Agridex	Competitor	Chem Rate	2,4-D Acres	Glyphosate Acres	Imazamox Acres	Penoxsulam Acres	Wind Speed
7/26/2018	0080	38	San Joaquin	28.80	28.70	700	1300	9.10	8.70	2.00	0.00	0.00	0.00	1.00	0.00	64	2.00	0.00	0.00	0.00	0-2
7/26/2018	3420	14	San Joaquin	27.40	27.60	800	1430	7.60	8.30	0.00	12.50	1.00	0.00	6.00	0.50	260	0.00	6.15	0.49	0.00	0-2
7/26/2018	3548	221	Sacramento	26.50	26.90	830	1200	7.10	7.40	0.00	7.50	0.00	0.00	4.00	0.00	200	0.00	4.80	0.00	0.00	0-2
7/26/2018	8834	8	San Joaquin	27.50	27.80	1100	1200	9.40	9.00	0.00	2.50	0.00	0.00	1.00	0.00	240	0.00	1.33	0.00	0.00	4-6
7/26/2018	9011	30	San Joaquin	28.60	29.40	1435	1605	8.00	7.80	0.00	2.75	0.00	0.00	2.00	0.00	256	0.00	1.38	0.00	0.00	6-8
7/26/2018	9011	31	San Joaquin	26.20	29.60	1025	1410	9.00	8.60	0.00	6.00	0.00	0.00	3.00	0.00	256	0.00	3.00	0.00	0.00	4-6
7/26/2018	9339	116	Contra Costa	23.90	24.10	900	1300	8.00	8.10	6.00	0.00	0.00	0.00	3.00	0.00	128	3.00	0.00	0.00	0.00	4-6
7/26/2018	9607	115	Contra Costa	23.70	23.90	900	1400	8.30	8.00	10.00	0.00	0.00	0.00	5.00	0.00	200	3.20	0.00	0.00	0.00	4-6
7/26/2018	FRESNO	910	Fresno	27.50	27.50	825	1045	6.90	6.90	0.00	8.00	0.00	0.00	0.06	0.00	256	0.00	4.00	0.00	0.00	2-4
7/26/2018	FRESNO	911	Fresno	27.50	27.50	1110	1300	6.90	6.90	0.00	2.00	0.00	0.00	0.06	0.00	256	0.00	1.00	0.00	0.00	2-4
7/26/2018	MERCED	410	Merced	27.30	29.10	1045	1300	8.95	8.97	0.00	0.04	0.00	0.00	0.02	0.00	96	0.00	0.05	0.00	0.00	0-2
7/26/2018	MERCED	412	Merced	25.10	27.30	740	1045	5.55	8.95	0.00	0.04	0.00	0.00	0.02	0.00	96	0.00	0.05	0.00	0.00	0-2
7/27/2018	9011	19	Sacramento	24.20	25.80	945	1533	6.50	7.30	6.25	0.00	0.00	0.00	3.00	0.00	128	3.13	0.00	0.00	0.00	4-6
7/27/2018	FRESNO	906	Fresno	27.00	27.00	1000	1100	7.50	7.50	0.00	0.33	0.00	0.00	0.03	0.00	256	0.00	0.17	0.00	0.00	2-4
7/27/2018	FRESNO	907	Fresno	25.70	27.00	900	1000	7.84	7.50	0.00	0.33	0.00	0.00	0.03	0.00	256	0.00	0.17	0.00	0.00	2-4
7/27/2018	FRESNO	908	Fresno	25.70	25.70	805	900	7.84	7.84	0.00	0.33	0.00	0.00	0.03	0.00	256	0.00	0.17	0.00	0.00	2-4
7/30/2018	0080	37	San Joaquin	28.40	28.30	700	1330	9.60	8.40	0.00	2.50	1.00	0.00	1.75	0.00	130	0.00	2.46	0.98	0.00	0-2
7/30/2018	3548	215	Sacramento	22.00	23.60	830	1330	7.70	8.40	0.00	12.50	0.00	0.00	5.50	0.00	200	0.00	8.00	0.00	0.00	0-2
7/30/2018	8834	280	Solano	23.60	23.20	730	1030	7.50	7.80	0.00	7.50	0.00	0.00	5.00	0.00	240	0.00	4.00	0.00	0.00	6-8
7/30/2018	9011	200	San Joaquin	23.30	27.10	955	1358	7.30	12.10	0.00	6.50	0.00	0.00	2.50	0.00	256	0.00	3.25	0.00	0.00	2-4
7/30/2018	9011	202	San Joaquin	24.50	25.60	1410	1519	8.10	9.10	0.00	2.50	0.00	0.00	1.25	0.00	256	0.00	1.25	0.00	0.00	6-8
7/30/2018	9607	112	Contra Costa	23.90	24.10	1000	1400	7.70	8.20	7.50	0.00	0.00	0.00	3.00	0.00	200	2.40	0.00	0.00	0.00	4-6
7/30/2018	MERCED	409	Merced	25.70	28.50	1045	1300	6.35	6.67	0.00	0.03	0.00	0.00	0.02	0.00	96	0.00	0.04	0.00	0.00	0-2
7/30/2018	MERCED	410	Merced	25.30	25.70	740	1045	6.07	6.35	0.00	0.04	0.00	0.00	0.02	0.00	96	0.00	0.05	0.00	0.00	0-2
7/31/2018	0080	36	San Joaquin	28.60	28.40	1000	1300	9.30	8.70	0.00	2.50	0.00	0.00	1.25	0.00	200	0.00	1.60	0.00	0.00	0-2
7/31/2018	0080	41	San Joaquin	28.60	28.40	1300	1500	10.10	7.90	2.50	0.00	0.00	0.00	1.25	0.00	200	0.80	0.00	0.00	0.00	0-2
7/31/2018	3420	65	San Joaquin	26.60	26.80	900	1230	8.80	7.90	1.50	0.00	0.00	0.00	0.75	0.00	1.4	68.57	0.00	0.00	0.00	0-2
7/31/2018	3548	214	Sacramento	21.60	22.40	830	1230	7.60	7.10	0.00	10.00	0.00	0.00	5.50	0.00	200	0.00	6.40	0.00	0.00	0-2
7/31/2018	8835	49	San Joaquin	27.00	28.00	900	1400	1.30	1.50	0.00	7.50	0.00	0.00	3.75	0.00	120	0.00	8.00	0.00	0.00	2-4
7/31/2018	9123	56	San Joaquin	25.10	25.70	930	1330	6.90	7.40	7.50	0.00	0.00	0.00	3.50	0.00	128	3.75	0.00	0.00	0.00	0-2
7/31/2018	9607	113	Contra Costa	25.20	25.50	1330	1500	8.40	8.10	5.00	0.00	0.00	0.00	2.50	0.00	200	1.60	0.00	0.00	0.00	4-6
7/31/2018	9607	851	Solano	24.80	25.00	1000	1100	8.00	8.00	0.50	0.00	0.00	0.00	0.25	0.00	200	0.16	0.00	0.00	0.00	6-8
7/31/2018	MERCED	409	Merced	25.70	28.50	740	1250	5.91	7.37	0.00	0.09	0.00	0.00	0.05	0.00	96	0.00	0.12	0.00	0.00	0-2
										151.71	407.60	32.00	0.00	263.39	16.50		135.98	245.03	23.17	0.00	

Table B-6. August 2018 Herbicide and Adjuvant Use

Date	Vessel ID	Site ID	County	Before Temp	After Temp	Time Arrived	Time Departed	DO Before	DO After	2,4-D	Glyphosate	Imazamox	Penoxsulam	Agridex	Competitor	Chem Rate	2,4-D Acres	Glyphosate Acres	Imazamox Acres	Penoxsulam Acres	Wind Speed
8/1/2018	3548	215	San Joaquin	21.90	23.40	900	1200	8.40	8.10	0.00	7.50	0.00	0.00	4.00	0.00	200	0.00	4.80	0.00	0.00	0-2
8/1/2018	8835	48	San Joaquin	23.90	24.20	900	1430	5.10	6.20	0.00	0.00	9.00	0.00	0.00	4.50	160	0.00	0.00	7.20	0.00	2-4
8/1/2018	9011	203	San Joaquin	25.10	28.00	1028	1430	7.60	7.50	0.00	7.50	0.00	0.00	3.00	0.00	256	0.00	3.75	0.00	0.00	2-4
8/1/2018	9123	56	San Joaquin	25.00	27.90	930	1330	7.16	6.10	6.50	0.00	0.00	0.00	3.25	0.00	128	3.25	0.00	0.00	0.00	0-2
8/1/2018	9339	65	San Joaquin	26.80	27.20	830	1430	8.10	9.30	5.00	0.00	0.00	0.00	2.50	0.00	140	2.29	0.00	0.00	0.00	0-2
8/2/2018	0085	28	San Joaquin	26.10	26.20	930	1430	8.40	7.90	0.00	12.50	0.00	0.00	6.00	0.00	192	0.00	8.33	0.00	0.00	6-8
8/2/2018	3548	217	Sacramento	23.40	25.20	900	1300	8.70	7.90	0.00	7.50	0.00	0.00	4.00	0.00	200	0.00	4.80	0.00	0.00	2-4
8/2/2018	8834	48	San Joaquin	23.60	25.80	900	1430	7.20	7.55	6.00	0.00	0.00	0.00	3.00	0.00	141	2.72	0.00	0.00	0.00	2-4
8/2/2018	8835	49	San Joaquin	25.20	20.00	800	1430	5.20	5.60	0.00	9.00	0.00	0.00	5.00	0.00	196	0.00	5.88	0.00	0.00	4-6
8/2/2018	9011	204	San Joaquin	22.50	25.80	900	1230	7.50	8.20	0.00	3.25	0.00	0.00	1.25	0.00	256	0.00	1.63	0.00	0.00	2-4
8/2/2018	9123	56	San Joaquin	24.10	26.40	900	1400	7.70	7.20	11.00	0.00	0.00	0.00	5.50	0.00	128	5.50	0.00	0.00	0.00	0-2
8/2/2018	9339	14	San Joaquin	26.50	27.30	900	1500	9.00	8.10	7.50	0.00	0.00	0.00	4.00	0.00	140	3.43	0.00	0.00	0.00	0-2
8/2/2018	MERCED	408	Merced	24.80	26.70	720	1340	5.52	7.06	0.00	0.07	0.00	0.00	0.04	0.00	96	0.00	0.09	0.00	0.00	0-2
8/3/2018	0006	214	Sacramento	25.20	25.20	800	1100	7.10	6.90	0.00	7.00	0.00	0.00	3.50	0.00	128	0.00	7.00	0.00	0.00	0-2
8/3/2018	0006	219	Sacramento	26.10	25.90	1130	1445	6.10	5.20	0.00	4.00	0.00	0.00	2.50	0.00	128	0.00	4.00	0.00	0.00	4-6
8/3/2018	3548	32	San Joaquin	25.00	26.50	810	1555	7.70	7.50	12.50	0.00	0.00	0.00	7.50	0.00	96	8.33	0.00	0.00	0.00	2-4
8/3/2018	9607	115	Contra Costa	23.70	23.90	800	1100	8.60	8.10	10.00	0.00	0.00	0.00	5.00	0.00	200	3.20	0.00	0.00	0.00	4-6
8/3/2018	9607	116	Contra Costa	24.30	24.50	1100	1500	7.90	8.30	2.50	0.00	0.00	0.00	2.50	0.00	200	0.80	0.00	0.00	0.00	4-6
8/3/2018	MERCED	408	Merced	24.20	26.10	730	1330	5.65	7.39	0.00	0.14	0.00	0.00	0.07	0.00	96	0.00	0.19	0.00	0.00	0-2
8/6/2018	0080	20	Sacramento	28.00	28.10	900	1430	10.60	9.30	0.00	7.50	0.00	0.00	3.75	0.00	228	0.00	4.21	0.00	0.00	0-2
8/6/2018	3548	28	San Joaquin	25.10	25.80	900	1230	7.60	7.10	0.00	10.00	0.00	0.00	5.00	0.00	200	0.00	6.40	0.00	0.00	2-4
8/6/2018	8834	176	Sacramento	20.10	22.40	730	1230	8.90	9.30	9.50	0.00	0.00	0.00	7.50	0.00	120	5.07	0.00	0.00	0.00	4-6
8/6/2018	9339	14	San Joaquin	26.10	26.50	830	1500	7.10	8.80	8.00	0.00	0.00	0.00	4.00	0.00	140	3.66	0.00	0.00	0.00	0-2
8/6/2018	9607	112	Contra Costa	23.90	24.40	800	1430	8.00	8.60	12.50	0.00	0.00	0.00	6.00	0.00	200	4.00	0.00	0.00	0.00	4-6
8/6/2018	MERCED	520	Merced	22.30	34.20	725	1340	0.55	1.95	0.00	0.30	0.00	0.00	0.15	0.00	96	0.00	0.40	0.00	0.00	0-2
8/7/2018	0080	32	San Joaquin	28.60	28.90	900	1000	9.70	8.80	2.50	0.00	0.00	0.00	1.25	0.00	128	1.25	0.00	0.00	0.00	0-2
8/7/2018	0080	33	San Joaquin	28.90	28.00	1000	1200	10.60	7.10	2.50	0.00	0.00	0.00	1.25	0.00	128	1.25	0.00	0.00	0.00	0-2
8/7/2018	0080	38	San Joaquin	28.40	27.90	1300	1500	8.30	8.70	0.00	0.00	2.00	0.00	0.00	0.00	128	0.00	0.00	2.00	0.00	0-2
8/7/2018	3548	215	Sacramento	21.00	23.60	830	1300	8.10	8.40	0.00	10.00	0.00	0.00	5.00	0.00	200	0.00	6.40	0.00	0.00	0-2
8/7/2018	8834	176	Sacramento	20.80	21.70	730	1330	8.70	9.00	10.00	0.00	0.00	0.00	6.50	0.00	120	5.33	0.00	0.00	0.00	4-6
8/7/2018	8835	74	San Joaquin	27.40	28.50	930	1130	7.35	7.52	2.50	0.00	0.00	0.00	1.25	0.00	120	1.33	0.00	0.00	0.00	2-4
8/7/2018	9123	56	San Joaquin	24.90	26.50	930	1330	7.79	7.03	5.00	0.00	0.00	0.00	2.50	0.00	128	2.50	0.00	0.00	0.00	0-2
8/7/2018	9339	74	San Joaquin	27.10	28.30	930	1130	7.50	6.50	2.50	0.00	0.00	0.00	1.25	0.00	140	1.14	0.00	0.00	0.00	0-2
8/7/2018	MERCED	521	Merced	20.40	26.70	1120	1350	9.20	10.77	0.00	0.05	0.00	0.00	0.03	0.00	96	0.00	0.07	0.00	0.00	0-2
8/7/2018	MERCED	522	Merced	18.10	20.40	745	1120	8.22	9.70	0.00	0.03	0.00	0.00	0.02	0.00	96	0.00	0.04	0.00	0.00	0-2
8/8/2018	0080	37	San Joaquin	28.60	29.10	800	1500	8.10	8.60	0.00	2.50	0.00	0.00	1.25	0.00	250	0.00	1.28	0.00	0.00	0-2
8/8/2018	3420	14	San Joaquin	27.30	28.50	900	1430	7.80	8.90	8.00	0.00	0.00	0.00	3.50	0.00	140	3.66	0.00	0.00	0.00	0-2
8/8/2018	3548	31	San Joaquin	25.70	26.10	900	1430	7.50	7.90	0.00	8.00	0.00	0.00	4.00	0.00	200	0.00	5.12	0.00	0.00	2-4
8/8/2018	8339	14	San Joaquin	23.10	25.80	900	1430	7.23	7.50	6.50	0.00	0.00	0.00	3.25	0.00	64	6.50	0.00	0.00	0.00	2-4
8/8/2018	8834	176	Sacramento	21.40	23.90	800	1300	9.20	11.70	5.00	0.00	0.00	0.00	2.50	0.00	120	2.67	0.00	0.00	0.00	4-6
8/8/2018	8835	45	San Joaquin	26.80	27.00	900	1430	6.10	6.00	0.00	0.00	6.00	0.00	0.00	3.00	128	0.00	0.00	6.00	0.00	2-4
8/8/2018	9123	96	Contra Costa	25.30	26.00	1100	1400	7.23	7.81	5.00	0.00	0.00	0.00	2.50	0.00	128	2.50	0.00	0.00	0.00	0-2
8/8/2018	MERCED	517	Merced	24.60	24.70	1130	1325	9.67	10.66	0.00	0.09	0.00	0.00	0.04	0.00	96	0.00	0.12	0.00	0.00	0-2
8/8/2018	MERCED	518	Merced	21.20	24.60	730	1130	8.53	9.67	0.00	0.10	0.00	0.00	0.05	0.00	96	0.00	0.13	0.00	0.00	0-2
8/9/2018	3548	26	San Joaquin	25.00	26.80	830	1200	7.20	7.00	5.00	0.00	0.00	0.00	2.50	0.00	150	2.13	0.00	0.00	0.00	0-2
8/9/2018	8339	48	San Joaquin	26.50	27.30	900	1430	7.40	7.58	5.00	0.00	0.00	0.00	3.25	0.00	120	2.67	0.00	0.00	0.00	2-4
8/9/2018	8834	176	Solano	25.80	25.20	1100	1330	8.60	9.40	5.00	0.00	0.00	0.00	2.50	0.00	120	2.67	0.00	0.00	0.00	2-4
8/9/2018	8835	47	San Joaquin	28.10	27.90	900	1130	5.10	5.30	0.00	0.00	4.00	0.00	0.00	2.00	128	0.00	0.00	4.00	0.00	0-2

Date	Vessel ID	Site ID	County	Before Temp	After Temp	Time Arrived	Time Departed	DO Before	DO After	2,4-D	Glyphosate	Imazamox	Penoxsulam	Agridex	Competitor	Chem Rate	2,4-D Acres	Glyphosate Acres	Imazamox Acres	Penoxsulam Acres	Wind Speed
8/9/2018	8835	49	San Joaquin	28.00	28.00	1200	1430	7.20	5.20	0.00	5.00	0.00	0.00	0.00	3.00	128	0.00	5.00	0.00	0.00	6-8
8/9/2018	9607	110	Contra Costa	24.10	24.60	800	1300	7.90	8.30	10.00	0.00	0.00	0.00	5.00	0.00	200	3.20	0.00	0.00	0.00	4-6
8/9/2018	MERCED	514	Merced	24.10	26.30	1105	1320	9.12	10.20	0.00	0.06	0.00	0.00	0.03	0.00	96	0.00	0.08	0.00	0.00	0-2
8/9/2018	MERCED	515	Merced	21.90	24.10	745	1105	8.81	9.12	0.00	0.10	0.00	0.00	0.05	0.00	96	0.00	0.13	0.00	0.00	0-2
8/10/2018	8835	65	San Joaquin	23.50	23.90	830	1430	9.15	8.75	0.00	0.00	8.00	0.00	0.00	5.00	128	0.00	0.00	8.00	0.00	4-6
8/10/2018	9607	128	Sacramento	24.30	24.70	900	1200	8.10	8.20	6.00	0.00	0.00	0.00	3.00	0.00	200	1.92	0.00	0.00	0.00	6-8
8/10/2018	9607	130	Sacramento	24.70	24.90	1200	1500	8.10	7.90	6.00	0.00	0.00	0.00	3.00	0.00	200	1.92	0.00	0.00	0.00	6-8
8/10/2018	MERCED	412	Merced	27.30	28.80	1135	1230	6.62	6.48	0.00	0.07	0.00	0.00	0.04	0.00	96	0.00	0.09	0.00	0.00	0-2
8/10/2018	MERCED	413	Merced	25.00	27.30	745	1135	6.57	6.62	0.00	0.12	0.00	0.00	0.06	0.00	96	0.00	0.16	0.00	0.00	0-2
8/13/2018	0080	19	Sacramento	28.00	27.90	1300	1400	9.10	8.80	4.00	0.00	0.00	0.00	2.00	0.00	250	1.02	0.00	0.00	0.00	0-2
8/13/2018	0080	20	Sacramento	28.00	28.00	1000	1300	9.60	8.10	0.00	5.00	0.00	0.00	2.50	0.00	250	0.00	2.56	0.00	0.00	0-2
8/13/2018	3548	280	Sacramento	22.40	22.80	930	1230	7.30	7.60	0.00	4.00	0.00	0.00	2.00	0.00	200	0.00	2.56	0.00	0.00	4-6
8/13/2018	8339	74	San Joaquin	23.20	25.70	900	1430	7.21	7.47	7.50	0.00	0.00	0.00	3.25	0.00	141	3.40	0.00	0.00	0.00	2-4
8/13/2018	8834	252	Sacramento	21.40	21.40	900	1000	7.80	7.80	0.00	2.00	0.00	0.00	1.00	0.00	240	0.00	1.07	0.00	0.00	2-4
8/13/2018	8834	262	Solano	22.30	22.60	1030	1230	7.20	7.50	0.00	3.50	0.00	0.00	1.50	0.00	240	0.00	1.87	0.00	0.00	4-6
8/13/2018	8835	74	San Joaquin	23.70	25.60	900	1430	8.10	8.80	7.50	0.00	0.00	0.00	0.00	3.50	140	3.43	0.00	0.00	0.00	0-2
8/13/2018	9122	28	San Joaquin	28.10	28.30	915	1415	9.10	8.80	0.00	15.00	0.00	0.00	7.00	0.00	256	0.00	7.50	0.00	0.00	2-4
8/13/2018	9607	107	Contra Costa	26.60	26.50	1300	1430	8.50	8.40	2.50	0.00	0.00	0.00	1.25	0.00	200	0.80	0.00	0.00	0.00	4-6
8/13/2018	9607	108	Contra Costa	26.30	26.40	1100	1300	8.10	8.10	2.50	0.00	0.00	0.00	1.25	0.00	200	0.80	0.00	0.00	0.00	4-6
8/13/2018	9607	109	Contra Costa	26.00	26.30	900	1100	8.60	8.30	5.00	0.00	0.00	0.00	2.50	0.00	200	1.60	0.00	0.00	0.00	4-6
8/13/2018	FRESNO	909	Fresno	25.50	25.60	1100	1200	7.90	8.20	0.00	2.50	0.00	0.00	0.06	0.00	256	0.00	1.25	0.00	0.00	2-4
8/13/2018	MERCED	512	Merced	26.40	27.90	1030	1340	9.14	9.78	0.00	0.00	0.00	0.00	0.04	0.00	96	0.00	0.00	0.00	0.00	0-2
8/13/2018	MERCED	513	Merced	23.00	26.40	720	1030	8.54	9.14	0.00	0.00	0.00	0.00	0.06	0.00	96	0.00	0.00	0.00	0.00	0-2
8/14/2018	3420	65	San Joaquin	24.60	25.50	830	1430	9.10	8.20	7.50	0.00	0.00	0.00	3.50	0.00	140	3.43	0.00	0.00	0.00	0-2
8/14/2018	3548	32	San Joaquin	22.40	22.80	1000	1230	7.50	7.60	5.00	0.00	0.00	0.00	2.50	0.00	140	2.29	0.00	0.00	0.00	2-4
8/14/2018	9607	107	Contra Costa	23.50	23.70	900	1200	8.00	8.10	7.50	0.00	0.00	0.00	3.75	0.00	200	2.40	0.00	0.00	0.00	4-6
8/14/2018	9607	173	Contra Costa	23.70	24.00	1200	1430	8.10	7.90	5.00	0.00	0.00	0.00	2.50	0.00	200	1.60	0.00	0.00	0.00	4-6
8/15/2018	0080	32	San Joaquin	28.10	28.60	800	1500	9.60	8.70	5.00	0.00	0.00	0.00	2.50	0.00	100	3.20	0.00	0.00	0.00	2-4
8/15/2018	3420	6	San Joaquin	26.50	27.10	830	1400	7.90	8.30	5.00	0.00	0.00	0.00	2.50	0.00	140	2.29	0.00	0.00	0.00	0-2
8/15/2018	3548	214	Sacramento	21.80	22.60	830	1300	8.50	8.90	0.00	10.00	0.00	0.00	5.00	0.00	200	0.00	6.40	0.00	0.00	2-4
8/15/2018	8834	280	Solano	20.30	21.00	900	1030	8.60	8.20	0.00	3.50	0.00	0.00	2.00	0.00	240	0.00	1.87	0.00	0.00	6-8
8/15/2018	8835	49	San Joaquin	27.10	26.90	900	1400	2.10	1.90	0.00	10.00	0.00	0.00	5.00	0.00	128	0.00	10.00	0.00	0.00	6-8
8/15/2018	9607	112	Contra Costa	24.40	24.60	1200	1330	8.30	8.50	5.00	0.00	0.00	0.00	2.50	0.00	200	1.60	0.00	0.00	0.00	4-6
8/15/2018	9607	116	Contra Costa	23.90	24.10	900	1200	7.80	8.00	7.50	0.00	0.00	0.00	3.75	0.00	200	2.40	0.00	0.00	0.00	4-6
8/15/2018	FRESNO	909	Fresno	25.00	25.00	830	1030	7.10	7.20	0.00	5.00	0.00	0.00	0.03	0.00	256	0.00	2.50	0.00	0.00	2-4
8/15/2018	FRESNO	910	Fresno	27.00	27.00	1030	1130	8.20	8.30	0.00	5.00	0.00	0.00	0.03	0.00	256	0.00	2.50	0.00	0.00	2-4
8/16/2018	0080	32	San Joaquin	28.60	28.10	800	1200	9.10	8.70	0.00	2.50	0.00	0.00	1.25	0.00	160	0.00	2.00	0.00	0.00	0-2
8/16/2018	0080	38	San Joaquin	28.10	28.00	1200	1400	7.60	8.10	5.00	0.00	0.00	0.00	2.50	0.00	160	2.00	0.00	0.00	0.00	0-2
8/16/2018	8834	272	Solano	21.40	21.60	1100	1300	8.70	8.60	0.00	5.00	0.00	0.00	2.50	0.00	240	0.00	2.67	0.00	0.00	6-8
8/16/2018	8834	278	Solano	20.60	20.40	800	1000	9.50	9.20	0.00	5.00	0.00	0.00	2.50	0.00	240	0.00	2.67	0.00	0.00	4-6
8/16/2018	8835	76	San Joaquin	26.20	25.60	800	1400	6.00	6.80	0.00	20.00	0.00	0.00	10.00	0.00	192	0.00	13.33	0.00	0.00	4-6
8/17/2018	8834	141	Sacramento	20.60	20.40	1100	1200	8.00	8.30	0.00	2.50	0.00	0.00	1.50	0.00	240	0.00	1.33	0.00	0.00	2-4
8/17/2018	8834	240	Sacramento	20.10	20.70	800	1030	7.40	8.20	0.00	7.50	0.00	0.00	5.00	0.00	240	0.00	4.00	0.00	0.00	2-4
8/17/2018	9123	107	Contra Costa	23.90	24.20	900	1130	7.70	8.00	5.00	0.00	0.00	0.00	0.00	0.00	200	1.60	0.00	0.00	0.00	4-6
8/17/2018	9123	110	Contra Costa	24.40	24.70	1200	1430	8.30	8.00	7.00	0.00	0.00	0.00	0.00	0.00	200	2.24	0.00	0.00	0.00	4-6
8/17/2018	FRESNO	909	Fresno	24.30	24.50	745	935	6.92	6.80	0.00	8.50	0.00	0.00	0.06	0.00	256	0.00	4.25	0.00	0.00	2-4
8/20/2018	3420	15	San Joaquin	26.10	25.80	830	1400	8.50	9.10	5.00	0.00	0.00	0.00	2.50	0.00	140	2.29	0.00	0.00	0.00	2-4
8/20/2018	3548	26	San Joaquin	24.30	26.40	830	1300	7.49	8.40	10.00	0.00	0.00	0.00	5.00	0.00	150	4.27	0.00	0.00	0.00	0-2
8/20/2018	8835	81	San Joaquin	23.70	24.00	900	1430	5.48	6.28	0.00	7.50	0.00	0.00	3.75	0.00	128	0.00	7.50	0.00	0.00	6-8
8/20/2018	9607	92	Contra Costa	24.60	25.00	930	1400	7.30	7.70	12.50	0.00	0.00	0.00	6.00	0.00	128	6.25	0.00	0.00	0.00	0-2

Date	Vessel ID	Site ID	County	Before Temp	After Temp	Time Arrived	Time Departed	DO Before	DO After	2,4-D	Glyphosate	Imazamox	Penoxsulam	Agridex	Competitor	Chem Rate	2,4-D Acres	Glyphosate Acres	Imazamox Acres	Penoxsulam Acres	Wind Speed
8/20/2018	FRESNO	909	Fresno	24.30	25.10	745	1300	7.04	6.85	0.00	8.00	0.00	0.00	0.06	0.00	256	0.00	4.00	0.00	0.00	2-4
8/21/2018	0080	39	San Joaquin	28.60	28.10	1030	1530	9.60	9.90	0.00	5.00	0.00	0.00	2.50	0.00	220	0.00	2.91	0.00	0.00	2-4
8/21/2018	3420	69	San Joaquin	25.10	25.30	830	1430	8.10	8.50	0.00	0.00	0.00	0.00	2.50	0.00	140	0.00	0.00	0.00	0.00	4-6
8/21/2018	3548	26	San Joaquin	24.60	26.10	900	1300	7.44	7.10	7.50	0.00	0.00	0.00	3.50	0.00	150	3.20	0.00	0.00	0.00	2-4
8/21/2018	9980	74	San Joaquin	22.20	23.10	900	1000	7.85	7.70	1.25	0.00	0.00	0.00	0.50	0.00	141	0.57	0.00	0.00	0.00	4-6
8/21/2018	FRESNO	906	Fresno	25.90	25.90	1200	1315	8.50	8.50	0.00	0.13	0.00	0.00	0.02	0.00	256	0.00	0.06	0.00	0.00	4-6
8/21/2018	FRESNO	907	Fresno	25.90	25.90	1030	1200	8.50	8.50	0.00	0.13	0.00	0.00	0.02	0.00	256	0.00	0.06	0.00	0.00	4-6
8/21/2018	FRESNO	908	Fresno	23.60	23.60	900	1030	8.54	8.54	0.00	0.13	0.00	0.00	0.02	0.00	256	0.00	0.06	0.00	0.00	4-6
8/21/2018	FRESNO	909	Fresno	23.60	23.60	730	900	8.54	8.54	0.00	0.13	0.00	0.00	0.02	0.00	256	0.00	0.06	0.00	0.00	4-6
8/23/2018	0080	29	San Joaquin	28.10	33.00	700	1000	9.70	10.30	0.00	2.50	0.00	0.00	1.50	0.00	200	0.00	1.60	0.00	0.00	4-6
8/23/2018	0080	32	San Joaquin	28.30	27.90	1000	1130	11.30	10.60	0.50	0.00	0.00	0.00	0.25	0.00	200	0.16	0.00	0.00	0.00	4-6
8/23/2018	0080	33	San Joaquin	28.10	23.10	1130	1330	9.10	9.80	2.00	0.00	0.00	0.00	1.00	0.00	200	0.64	0.00	0.00	0.00	4-6
8/23/2018	0080	36	San Joaquin	28.30	28.10	1330	1500	7.90	8.60	0.00	2.50	0.00	0.00	1.50	0.00	200	0.00	1.60	0.00	0.00	4-6
8/23/2018	3420	58	San Joaquin	25.10	26.20	900	1400	7.60	8.20	5.00	0.00	0.00	0.00	2.50	0.00	140	2.29	0.00	0.00	0.00	4-6
8/23/2018	9122	28	San Joaquin	28.30	28.20	815	1430	7.90	8.40	0.00	10.00	0.00	0.00	5.00	0.00	128	0.00	10.00	0.00	0.00	6-8
8/23/2018	9607	134	Contra Costa	23.50	23.90	800	1430	7.70	7.90	10.00	0.00	0.00	0.00	5.00	0.00	200	3.20	0.00	0.00	0.00	4-6
8/23/2018	9980	74	San Joaquin	21.70	22.80	745	1200	7.51	7.33	7.25	0.00	0.00	0.00	3.50	0.00	141	3.29	0.00	0.00	0.00	2-4
8/24/2018	8834	133	Contra Costa	23.60	23.80	900	1330	7.70	7.50	12.50	0.00	0.00	0.00	6.00	0.00	240	3.33	0.00	0.00	0.00	4-6
8/24/2018	8835	74	San Joaquin	24.10	24.80	800	1500	5.20	5.30	0.00	15.00	0.00	0.00	7.50	0.00	128	0.00	15.00	0.00	0.00	6-8
8/24/2018	9011	20	Sacramento	20.10	24.50	852	1400	6.90	6.50	0.00	16.00	0.00	0.00	6.50	0.00	256	0.00	8.00	0.00	0.00	8-10
8/24/2018	9607	133	Contra Costa	24.70	26.20	900	1430	7.70	8.10	12.50	0.00	0.00	0.00	6.00	0.00	200	4.00	0.00	0.00	0.00	4-6
8/27/2018	3420	68	San Joaquin	24.30	25.10	830	1430	9.10	8.30	5.00	0.00	0.00	0.00	2.50	0.00	140	2.29	0.00	0.00	0.00	2-4
8/27/2018	3548	205	Sacramento	20.00	22.10	900	1400	8.20	7.80	0.00	12.50	0.00	0.00	6.50	0.00	200	0.00	8.00	0.00	0.00	2-4
8/27/2018	9011	203	Sacramento	21.70	24.20	923	1457	6.20	9.10	0.00	10.00	0.00	0.00	4.50	0.00	200	0.00	6.40	0.00	0.00	3.9
8/27/2018	9607	133	Contra Costa	23.80	24.90	830	1430	7.90	8.30	12.50	0.00	0.00	0.00	6.00	0.00	200	4.00	0.00	0.00	0.00	4-6
8/27/2018	9980	317	Stanislaus	23.10	23.30	1230	1345	8.22	7.80	0.00	1.25	0.00	0.00	0.50	0.00	190	0.00	0.84	0.00	0.00	4-6
8/27/2018	9980	318	Stanislaus	22.50	23.10	1100	1230	7.59	8.22	0.00	3.25	0.00	0.00	1.50	0.00	190	0.00	2.19	0.00	0.00	4-6
8/27/2018	9980	319	Stanislaus	22.30	22.50	930	1100	7.62	7.59	0.00	3.00	0.00	0.00	1.50	0.00	190	0.00	2.02	0.00	0.00	2-4
8/28/2018	3420	15	San Joaquin	24.80	25.20	800	1430	9.30	7.30	7.50	0.00	1.00	0.00	4.00	0.00	140	3.43	0.00	0.91	0.00	2-4
8/28/2018	3548	203	San Joaquin	20.00	22.80	830	1300	8.30	8.90	0.00	10.00	0.00	0.00	5.00	0.00	200	0.00	6.40	0.00	0.00	2-4
8/28/2018	9011	203	San Joaquin	21.80	22.60	838	1345	8.10	8.10	0.00	8.00	0.00	0.00	3.00	0.00	200	0.00	5.12	0.00	0.00	8-10
8/28/2018	9011	206	San Joaquin	22.80	22.80	1404	1452	9.00	14.50	0.00	1.00	0.00	0.00	0.25	0.00	200	0.00	0.64	0.00	0.00	6-8
8/28/2018	9607	112	Contra Costa	23.70	24.30	900	1430	6.20	7.90	12.50	0.00	0.00	0.00	6.00	0.00	200	4.00	0.00	0.00	0.00	4-6
8/28/2018	9980	317	Stanislaus	23.20	23.70	1230	1430	8.41	7.45	0.00	4.25	0.00	0.00	2.25	0.00	190	0.00	2.86	0.00	0.00	2-4
8/28/2018	9980	318	Stanislaus	22.70	23.20	1015	1215	8.30	8.41	0.00	3.00	0.00	0.00	1.75	0.00	190	0.00	2.02	0.00	0.00	2-4
8/28/2018	9980	319	Stanislaus	22.40	22.70	830	1000	8.17	8.30	0.00	2.00	0.00	0.00	1.00	0.00	190	0.00	1.35	0.00	0.00	2-4
8/29/2018	3420	14	San Joaquin	23.50	23.50	845	1500	9.00	8.10	7.50	0.00	0.00	0.00	3.50	0.00	140	3.43	0.00	0.00	0.00	4-6
8/29/2018	3548	26	San Joaquin	20.10	22.40	930	1230	8.40	7.80	5.00	0.00	0.00	0.00	2.50	0.00	150	2.13	0.00	0.00	0.00	2-4
8/29/2018	9122	28	San Joaquin	21.60	21.40	900	1345	8.10	8.60	0.00	10.00	0.00	0.00	5.00	0.00	250	0.00	5.12	0.00	0.00	6-8
8/30/2018	3420	76	San Joaquin	24.10	24.70	900	1430	8.50	7.30	12.50	0.00	0.00	0.00	6.00	0.00	140	5.71	0.00	0.00	0.00	0-2
8/30/2018	8835	48	San Joaquin	24.00	25.10	1100	1500	7.00	5.80	0.00	21.50	0.00	0.00	11.00	0.00	192	0.00	14.33	0.00	0.00	4-6
8/30/2018	8835	49	San Joaquin	23.60	24.00	900	1100	6.20	6.10	0.00	6.00	0.00	0.00	3.00	0.00	192	0.00	4.00	0.00	0.00	2-4
8/30/2018	9011	37	San Joaquin	20.30	26.20	835	1518	0.20	12.60	0.00	15.25	0.00	0.00	4.75	0.00	200	0.00	9.76	0.00	0.00	2-4
8/30/2018	9123	110	Contra Costa	24.10	24.50	900	1400	8.30	7.90	12.50	0.00	0.00	0.00	5.00	0.00	200	4.00	0.00	0.00	0.00	4-6
8/31/2018	3420	76	San Joaquin	23.60	24.10	900	1400	7.40	7.80	7.50	0.00	0.00	0.00	3.50	0.00	140	3.43	0.00	0.00	0.00	0-2
8/31/2018	9011	77	San Joaquin	22.30	25.20	950	1440	0.10	2.87	0.00	6.00	0.00	0.00	3.75	0.00	50	0.00	15.36	0.00	0.00	6.8
8/31/2018	9123	112	Contra Costa	23.80	24.10	900	1500	7.70	8.30	12.50	0.00	0.00	0.00	6.00	0.00	200	4.00	0.00	0.00	0.00	4-6
										452.00	402.88	30.00	0.00	402.74	21.00		190.88	277.70	28.11	0.00	

Table B-7. September 2018 Herbicide and Adjuvant Use

Date	Vessel ID	Site ID	County	Before Temp	After Temp	Time Arrived	Time Departed	DO Before	DO After	2,4-D	Glyphosate	Imazamox	Penoxsulam	Agridex	Competitor	Chem Rate	2,4-D Acres	Glyphosate Acres	Imazamox Acres	Penoxsulam Acres	Wind Speed
9/4/2018	3420	75	San Joaquin	23.10	23.50	900	1430	7.10	8.60	12.50	0.00	0.00	0.00	6.50	0.00	140	5.71	0.00	0.00	0.00	0-2
9/4/2018	3548	215	Sacramento	20.30	22.60	900	1300	7.40	7.90	0.00	6.00	0.00	0.00	3.00	0.00	200	0.00	3.84	0.00	0.00	2-4
9/4/2018	8836	713	Stanislaus	22.60	21.40	1030	1430	9.27	10.01	0.00	4.00	0.00	0.00	2.00	0.00	128	0.00	4.00	0.00	0.00	4-6
9/4/2018	9607	108	Contra Costa	24.30	24.70	900	1100	8.50	8.20	6.50	0.00	0.00	0.00	3.00	0.00	200	2.08	0.00	0.00	0.00	4-6
9/4/2018	9607	109	Contra Costa	24.60	24.90	1100	1430	8.80	8.60	6.00	0.00	0.00	0.00	3.00	0.00	200	1.92	0.00	0.00	0.00	4-6
9/4/2018	9980	713	Stanislaus	21.70	22.80	1115	1330	9.20	9.40	0.00	2.50	0.00	0.00	1.25	0.00	190	0.00	1.68	0.00	0.00	2-4
9/4/2018	9980	714	Stanislaus	20.80	21.40	930	1045	8.84	9.10	0.00	1.50	0.00	0.00	0.75	0.00	190	0.00	1.01	0.00	0.00	2-4
9/5/2018	3548	215	Sacramento	21.40	21.00	900	1400	8.30	8.90	0.00	12.50	0.00	0.00	6.00	0.00	200	0.00	8.00	0.00	0.00	2-4
9/5/2018	9011	58	San Joaquin	22.00	24.30	1048	1306	6.50	9.40	2.00	0.00	0.00	0.00	1.75	0.00	200	0.64	0.00	0.00	0.00	6-8
9/5/2018	9607	109	Contra Costa	24.10	24.70	900	1400	8.00	8.40	12.50	0.00	0.00	0.00	6.00	0.00	200	4.00	0.00	0.00	0.00	4-6
9/6/2018	3548	76	San Joaquin	22.60	24.20	930	1400	7.10	7.60	12.00	0.00	0.00	0.00	6.00	0.00	150	5.12	0.00	0.00	0.00	0-2
9/6/2018	9011	75	San Joaquin	23.30	23.10	940	1510	6.00	6.00	11.75	0.00	0.00	0.00	4.75	0.00	200	3.76	0.00	0.00	0.00	4-6
9/10/2018	3420	76	San Joaquin	23.10	23.50	900	1430	8.20	7.80	7.50	0.00	0.00	0.00	3.50	0.00	140	3.43	0.00	0.00	0.00	0-2
9/10/2018	3548	219	Sacramento	19.90	22.80	830	1330	8.50	8.90	0.00	12.50	0.00	0.00	6.00	0.00	200	0.00	8.00	0.00	0.00	2-4
9/10/2018	9011	205	San Joaquin	20.20	26.90	930	1300	0.20	0.10	0.00	8.25	0.00	0.00	4.00	0.00	200	0.00	5.28	0.00	0.00	2-4
9/10/2018	9606	38	San Joaquin	29.10	29.00	730	1030	9.60	8.10	5.00	0.00	0.00	0.00	2.50	0.00	100	3.20	0.00	0.00	0.00	0-2
9/10/2018	9607	133	Contra Costa	24.50	25.10	1000	1430	7.70	7.50	12.50	0.00	0.00	0.00	6.00	0.00	200	4.00	0.00	0.00	0.00	6-8
9/10/2018	9980	77	San Joaquin	22.00	24.00	930	1330	8.10	8.23	10.00	0.00	0.00	0.00	5.00	0.00	141	4.54	0.00	0.00	0.00	2-4
9/11/2018	0006	92	San Joaquin	22.70	21.60	800	1100	7.20	8.55	0.00	7.50	0.00	0.00	4.00	0.00	160	0.00	6.00	0.00	0.00	2-4
9/11/2018	0055	108	Contra Costa	24.00	24.10	1000	1045	8.50	8.40	0.00	0.00	0.00	0.00	0.00	0.00	7.5-15	0.00	0.00	0.00	0.00	6-8
9/11/2018	0055	109	Contra Costa	24.20	24.30	1100	1200	8.40	8.40	0.00	0.00	0.00	0.00	0.00	0.00	7.5-15	0.00	0.00	0.00	0.00	6-8
9/11/2018	3420	32	San Joaquin	23.30	23.50	1100	1500	8.50	7.60	2.50	0.00	0.00	0.00	1.25	0.00	140	1.14	0.00	0.00	0.00	4-6
9/11/2018	3548	215	Sacramento	21.10	23.60	900	1400	8.60	7.90	0.00	13.00	0.00	0.00	6.50	0.00	200	0.00	8.32	0.00	0.00	2-4
9/11/2018	9011	286	Sacramento	22.10	23.10	1243	1505	8.00	7.50	0.00	1.50	0.00	0.00	0.75	0.00	200	0.00	0.96	0.00	0.00	2-4
9/11/2018	9980	74	San Joaquin	22.10	23.50	915	1300	7.45	7.71	5.00	0.00	0.00	0.00	2.50	0.00	141	2.27	0.00	0.00	0.00	2-4
9/12/2018	3420	76	San Joaquin	22.60	23.20	830	1230	8.10	7.20	5.00	0.00	0.00	0.00	2.50	0.00	140	2.29	0.00	0.00	0.00	6-8
9/12/2018	3548	221	Sacramento	21.60	22.10	1030	1330	7.20	7.40	0.00	4.50	0.00	0.00	2.00	0.00	200	0.00	2.88	0.00	0.00	4-6
9/12/2018	9011	209	Sacramento	21.60	21.70	1301	1458	10.03	9.00	0.00	1.25	0.00	0.00	0.50	0.00	200	0.00	0.80	0.00	0.00	2-4
9/12/2018	9011	210	Sacramento	21.40	21.60	1120	1247	10.90	10.30	0.00	1.00	0.00	0.00	0.25	0.00	200	0.00	0.64	0.00	0.00	4-6
9/12/2018	9011	211	Sacramento	20.60	21.40	950	1116	8.80	10.90	0.00	0.75	0.00	0.00	0.25	0.00	200	0.00	0.48	0.00	0.00	4-6
9/12/2018	9607	42	San Joaquin	28.00	28.10	1000	1500	9.60	7.90	0.00	5.00	0.00	0.00	2.50	0.00	140	0.00	4.57	0.00	0.00	4-6
9/13/2018	0006	8	San Joaquin	24.90	23.00	1330	1400	6.49	6.20	0.00	1.50	0.00	0.00	0.75	0.00	192	0.00	1.00	0.00	0.00	4-6
9/13/2018	0006	10	San Joaquin	22.50	22.80	830	1130	7.59	7.27	0.00	8.50	0.00	0.00	4.25	0.00	192	0.00	5.67	0.00	0.00	4-6
9/13/2018	3420	76	San Joaquin	22.50	23.60	830	1430	8.60	7.10	10.00	0.00	0.00	0.00	5.00	0.00	140	4.57	0.00	0.00	0.00	2-4
9/13/2018	3548	76	San Joaquin	24.70	24.90	1200	1400	8.00	7.20	4.50	0.00	0.00	0.00	2.00	0.00	150	1.92	0.00	0.00	0.00	2-4
9/13/2018	3548	77	San Joaquin	22.40	24.60	930	1200	8.50	8.20	6.50	0.00	0.00	0.00	3.00	0.00	150	2.77	0.00	0.00	0.00	2-4
9/13/2018	9011	20	Sacramento	19.40	23.90	825	1301	7.00	5.80	0.00	13.00	0.00	0.00	4.25	0.00	256	0.00	6.50	0.00	0.00	8-10
9/13/2018	9607	133	Contra Costa	24.60	25.00	900	1430	7.90	8.00	12.50	0.00	0.00	0.00	6.00	0.00	200	4.00	0.00	0.00	0.00	4-6
9/13/2018	9980	74	San Joaquin	21.80	23.30	745	1400	7.37	7.75	10.00	0.00	0.00	0.00	4.50	0.00	141	4.54	0.00	0.00	0.00	2-4
9/14/2018	0006	92	Contra Costa	21.80	23.10	830	1430	9.95	10.31	0.00	17.50	0.00	0.00	0.00	0.00	162	0.00	13.83	0.00	0.00	2-4
9/14/2018	3420	76	San Joaquin	22.20	22.50	830	1430	8.80	7.00	7.50	0.00	0.00	0.00	3.50	0.00	140	3.43	0.00	0.00	0.00	0-2
9/14/2018	3548	47	San Joaquin	20.90	21.60	830	1400	8.40	8.00	15.00	0.00	0.00	0.00	7.50	0.00	150	6.40	0.00	0.00	0.00	2-4
9/14/2018	9011	74	San Joaquin	18.40	24.50	851	1448	2.50	9.80	9.00	0.00	0.00	0.00	7.50	0.00	256	2.25	0.00	0.00	0.00	4-6
9/15/2018	3548	133	Solano	20.60	22.40	900	1400	9.20	8.10	15.00	0.00	0.00	0.00	7.50	0.00	150	6.40	0.00	0.00	0.00	2-4
9/15/2018	9607	133	Contra Costa	8.20	8.10	900	1330	8.20	8.10	15.00	0.00	0.00	0.00	7.00	0.00	15	64.00	0.00	0.00	0.00	4-6
9/17/2018	0006	97	Contra Costa	22.90	23.00	830	1330	6.20	6.80	0.00	9.00	0.00	0.00	4.50	0.00	128	0.00	9.00	0.00	0.00	2-4
9/17/2018	3420	14	San Joaquin	21.80	22.10	830	1500	8.50	9.30	0.00	10.00	0.00	0.00	5.00	0.00	130	0.00	9.85	0.00	0.00	4-6
9/17/2018	9011	20	Sacramento	19.10	24.00	900	1501	7.10	7.10	0.00	14.25	0.00	0.00	7.00	0.00	256	0.00	7.13	0.00	0.00	2-4

Date	Vessel ID	Site ID	County	Before Temp	After Temp	Time Arrived	Time Departed	DO Before	DO After	2,4-D	Glyphosate	Imazamox	Penoxsulam	Agridex	Competitor	Chem Rate	2,4-D Acres	Glyphosate Acres	Imazamox Acres	Penoxsulam Acres	Wind Speed
9/17/2018	9607	112	Contra Costa	23.70	23.90	930	1430	8.40	8.70	0.00	15.00	0.00	0.00	7.50	0.00	15	0.00	128.00	0.00	0.00	4-6
9/17/2018	9980	8	San Joaquin	21.50	22.20	1130	1415	8.20	8.11	0.00	5.00	0.00	0.00	2.50	0.00	190	0.00	3.37	0.00	0.00	4-6
9/18/2018	3420	15	San Joaquin	21.40	21.80	830	1500	7.10	8.20	0.00	12.50	0.00	0.00	6.50	0.00	130	0.00	12.31	0.00	0.00	0-2
9/18/2018	3548	100	San Joaquin	20.30	22.40	930	1330	8.10	7.60	0.00	10.00	0.00	0.00	5.00	0.00	200	0.00	6.40	0.00	0.00	2-4
9/19/2018	0006	62	San Joaquin	23.10	23.80	900	1100	7.20	6.80	0.00	3.00	0.00	0.00	1.75	0.00	128	0.00	3.00	0.00	0.00	6-8
9/19/2018	0037	251	Sacramento	17.90	17.80	830	1030	9.70	9.50	0.00	3.00	0.00	0.00	1.00	0.00	240	0.00	1.60	0.00	0.00	4-6
9/19/2018	0037	267	Solano	21.30	21.00	1100	1430	9.70	9.40	0.00	8.00	0.00	0.00	3.00	0.00	240	0.00	4.27	0.00	0.00	4-6
9/19/2018	3420	14	San Joaquin	21.10	22.10	1100	1500	7.90	7.60	0.00	5.00	0.00	0.00	2.50	0.00	130	0.00	4.92	0.00	0.00	6-8
9/19/2018	3420	15	San Joaquin	19.90	20.20	930	1030	8.40	8.20	0.00	0.00	2.00	0.00	0.00	1.00	130	0.00	0.00	1.97	0.00	2-4
9/19/2018	9011	20	Sacramento	19.90	22.50	950	1500	7.00	7.30	0.00	12.50	0.00	0.00	5.00	0.00	256	0.00	6.25	0.00	0.00	2-4
9/19/2018	9122	303	San Joaquin	22.40	23.10	900	1100	7.42	8.10	0.00	2.25	0.00	0.00	1.25	0.00	190	0.00	1.52	0.00	0.00	2-4
9/20/2018	3548	217	Sacramento	20.40	21.60	830	1330	7.60	7.20	0.00	15.00	0.00	0.00	7.50	0.00	200	0.00	9.60	0.00	0.00	2-4
9/20/2018	9011	205	San Joaquin	18.90	26.50	835	1500	0.40	2.30	0.00	9.25	0.00	0.00	3.00	0.00	256	0.00	4.63	0.00	0.00	0-2
9/20/2018	9606	40	San Joaquin	20.90	20.00	900	1300	11.80	9.40	0.00	10.00	0.00	0.00	5.00	0.00	200	0.00	6.40	0.00	0.00	4-6
9/20/2018	9607	133	Contra Costa	23.70	24.00	900	1430	8.80	9.20	0.00	12.50	0.00	0.00	6.00	0.00	200	0.00	8.00	0.00	0.00	4-6
9/20/2018	9980	74	San Joaquin	20.20	21.20	900	1430	6.80	6.20	0.00	10.00	0.00	0.00	5.00	0.00	130	0.00	9.85	0.00	0.00	2-4
9/21/2018	9011	49	San Joaquin	21.00	23.70	1130	1500	13.70	7.50	0.00	5.75	0.00	0.00	3.00	0.00	256	0.00	2.88	0.00	0.00	2-4
9/21/2018	9011	52	San Joaquin	23.20	23.60	920	1130	8.40	8.80	0.00	4.25	0.00	0.00	1.50	0.00	256	0.00	2.13	0.00	0.00	2-4
9/23/2018	9980	74	San Joaquin	22.10	23.40	1030	1430	7.08	7.22	0.00	5.00	0.00	0.00	2.50	0.00	190	0.00	3.37	0.00	0.00	4-6
9/24/2018	3420	8	San Joaquin	20.10	20.60	1000	1500	8.10	8.60	0.00	7.50	0.00	0.00	3.50	0.00	130	0.00	7.38	0.00	0.00	0-2
9/24/2018	9606	36	San Joaquin	24.00	24.10	1300	1400	8.60	7.10	0.00	2.00	0.00	0.00	1.00	0.00	200	0.00	1.28	0.00	0.00	0-2
9/24/2018	9606	37	San Joaquin	24.00	23.90	900	1300	9.50	8.20	0.00	7.50	0.00	0.00	3.75	0.00	200	0.00	4.80	0.00	0.00	0-2
9/24/2018	9607	117	Contra Costa	24.20	24.70	1300	1500	8.30	8.50	0.00	5.00	0.00	0.00	2.50	0.00	200	0.00	3.20	0.00	0.00	4-6
9/25/2018	3420	9	San Joaquin	20.10	21.50	800	1500	9.00	6.10	0.00	12.50	0.00	0.00	6.50	0.00	130	0.00	12.31	0.00	0.00	0-2
9/25/2018	9011	20	Sacramento	19.90	26.80	830	1500	6.20	6.50	0.00	14.25	0.00	0.00	3.00	0.00	256	0.00	7.13	0.00	0.00	2-4
9/25/2018	9123	109	Contra Costa	20.30	20.40	1000	1400	8.60	8.60	0.00	4.00	0.00	0.00	2.00	0.00	256	0.00	2.00	0.00	0.00	4-6
9/25/2018	9607	109	Contra Costa	23.60	24.30	900	1430	7.90	8.30	0.00	10.00	0.00	0.00	5.00	0.00	200	0.00	6.40	0.00	0.00	4-6
9/26/2018	3420	9	San Joaquin	20.30	21.50	800	1500	9.10	6.50	0.00	12.50	0.00	0.00	0.00	0.00	130	0.00	12.31	0.00	0.00	0-2
9/26/2018	9011	84	Contra Costa	21.40	22.80	1000	1430	8.10	9.50	0.00	9.00	0.00	0.00	3.00	0.00	256	0.00	4.50	0.00	0.00	0-2
9/26/2018	9607	129	Sacramento	18.70	19.00	830	1500	7.10	7.70	0.00	15.00	0.00	0.00	7.50	0.00	200	0.00	9.60	0.00	0.00	4-6
9/27/2018	0037	267	Solano	18.20	20.60	800	1200	8.60	7.90	0.00	12.00	0.00	0.00	5.00	0.00	240	0.00	6.40	0.00	0.00	2-4
9/27/2018	0037	272	Solano	21.40	21.80	1200	1430	8.20	8.30	0.00	3.00	0.00	0.00	1.00	0.00	240	0.00	1.60	0.00	0.00	2-4
9/27/2018	3420	9	San Joaquin	20.10	20.80	830	1430	8.60	8.30	0.00	10.00	0.00	0.00	5.00	0.00	130	0.00	9.85	0.00	0.00	0-2
9/28/2018	9606	262	Solano	20.40	21.00	1100	1330	7.50	7.00	0.00	3.50	0.00	0.00	2.00	0.00	240	0.00	1.87	0.00	0.00	6-8
9/28/2018	9980	262	Solano	20.10	20.50	1100	1330	7.10	7.30	0.00	1.50	0.00	0.00	0.75	0.00	130	0.00	1.48	0.00	0.00	6-8
										215.75	432.75	2.00	0.00	294.25	1.00		144.38	420.00	1.97	0.00	

Table B-8. October 2018 Herbicide and Adjuvant Use

Date	Vessel ID	Site ID	County	Before Temp	After Temp	Time Arrived	Time Departed	DO Before	DO After	2,4-D	Glyphosate	Imazamox	Penoxsulam	Agridex	Competitor	Chem Rate	2,4-D Acres	Glyphosate Acres	Imazamox Acres	Penoxsulam Acres	Wind Speed
10/1/2018	0037	282	Solano	20.30	20.50	1230	1500	8.20	8.00	0.00	10.00	0.00	0.00	5.00	0.00	240	0.00	5.33	0.00	0.00	2-4
10/1/2018	3420	62	San Joaquin	19.20	19.60	830	1500	7.80	8.70	0.00	11.00	0.00	0.00	5.50	0.00	130	0.00	10.83	0.00	0.00	0-2
10/1/2018	3545	117	Contra Costa	19.80	20.60	930	1330	8.20	7.40	0.00	10.00	0.00	0.00	5.00	0.00	200	0.00	6.40	0.00	0.00	2-4
10/1/2018	8835	47	San Joaquin	26.00	26.10	900	1300	7.80	7.30	0.00	6.00	0.00	0.00	3.00	0.00	192	0.00	4.00	0.00	0.00	0-2
10/1/2018	9607	116	Contra Costa	20.20	20.70	1000	1430	8.40	8.60	0.00	7.50	0.00	0.00	0.00	0.00	200	0.00	4.80	0.00	0.00	4-6
10/1/2018	9607	117	Contra Costa	19.90	19.90	930	1000	8.50	8.40	0.00	2.50	0.00	0.00	0.00	0.00	200	0.00	1.60	0.00	0.00	4-6
10/1/2018	9980	74	San Joaquin	21.30	22.10	915	1430	7.10	7.30	0.00	10.00	0.00	0.00	5.00	0.00	190	0.00	6.74	0.00	0.00	2-4
10/2/2018	0068	65	San Joaquin	21.20	21.00	900	1500	9.80	7.30	0.00	7.50	0.00	0.00	3.75	0.00	200	0.00	4.80	0.00	0.00	0-2
10/2/2018	3548	216	Sacramento	17.80	19.10	1000	1200	8.30	8.90	0.00	4.00	0.00	0.00	2.00	0.00	200	0.00	2.56	0.00	0.00	2-4
10/3/2018	0037	281	Solano	21.10	20.80	1000	1130	8.10	8.50	0.00	2.50	0.00	0.00	1.50	0.00	240	0.00	1.33	0.00	0.00	2-4
10/3/2018	3420	8	San Joaquin	18.30	18.80	800	1500	7.10	9.10	0.00	12.50	0.00	0.00	6.00	0.00	130	0.00	12.31	0.00	0.00	0-2
10/3/2018	9607	109	Contra Costa	19.60	19.90	900	1400	7.80	8.10	0.00	10.00	0.00	0.00	5.00	0.00	200	0.00	6.40	0.00	0.00	4-6
10/4/2018	3420	61	San Joaquin	19.40	19.80	1030	1400	7.40	8.90	0.00	6.50	0.00	0.00	3.50	0.00	130	0.00	6.40	0.00	0.00	2-4
10/4/2018	3420	62	San Joaquin	19.10	19.40	830	1000	6.90	7.30	0.00	6.00	0.00	0.00	3.00	0.00	130	0.00	5.91	0.00	0.00	0-2
10/4/2018	9011	205	San Joaquin	19.40	20.20	1105	1505	0.80	2.40	0.00	9.00	0.00	0.00	2.75	0.00	256	0.00	4.50	0.00	0.00	4-6
10/4/2018	9123	109	Contra Costa	20.80	21.30	930	1400	8.30	8.10	0.00	12.50	0.00	0.00	6.00	0.00	200	0.00	8.00	0.00	0.00	4-6
10/4/2018	964121	79	Alameda	21.20	21.90	1130	1300	8.45	9.10	0.00	5.00	0.00	0.00	2.50	0.00	190	0.00	3.37	0.00	0.00	4-6
10/4/2018	9980	32	San Joaquin	21.10	20.90	900	1500	9.80	8.60	0.00	12.50	0.00	0.00	6.25	0.00	210	0.00	7.62	0.00	0.00	0-2
10/5/2018	8834	128	Sacramento	17.70	17.80	900	1400	7.40	8.20	0.00	15.00	0.00	0.00	7.00	0.00	240	0.00	8.00	0.00	0.00	2-4
10/5/2018	9607	127	Sacramento	19.70	20.60	900	1200	7.70	8.30	0.00	7.00	0.00	0.00	3.50	0.00	200	0.00	4.48	0.00	0.00	4-6
10/5/2018	9607	130	Sacramento	20.40	20.70	1200	1430	8.10	8.30	0.00	8.00	0.00	0.00	4.00	0.00	200	0.00	5.12	0.00	0.00	4-6
10/5/2018	9980	32	San Joaquin	19.60	20.00	630	1300	7.90	8.10	0.00	7.50	0.00	0.00	3.75	0.00	210	0.00	4.57	0.00	0.00	0-2
10/5/2018	9980	38	San Joaquin	20.10	19.90	1330	1530	10.60	9.10	0.00	7.50	0.00	0.00	3.75	0.00	210	0.00	4.57	0.00	0.00	0-2
10/8/2018	0006	74	San Joaquin	19.00	22.30	900	1430	5.20	6.30	0.00	15.00	0.00	0.00	7.50	0.00	128	0.00	15.00	0.00	0.00	4-6
10/8/2018	0037	282	Solano	18.70	18.50	900	1300	9.80	9.20	0.00	7.50	0.00	0.00	5.00	0.00	240	0.00	4.00	0.00	0.00	2-4
10/8/2018	3420	15	San Joaquin	18.60	19.10	800	1500	8.50	7.50	0.00	12.50	0.00	0.00	6.00	0.00	130	0.00	12.31	0.00	0.00	0-2
10/8/2018	3548	121	Contra Costa	19.00	19.60	930	1400	8.90	9.30	0.00	14.00	0.00	0.00	7.00	0.00	200	0.00	8.96	0.00	0.00	2-4
10/8/2018	9011	201	San Joaquin	19.90	19.80	1308	1530	11.10	9.00	0.00	1.50	0.00	0.00	0.50	0.00	256	0.00	0.75	0.00	0.00	4-6
10/8/2018	9011	202	San Joaquin	18.10	20.70	935	1253	9.00	9.20	0.00	3.00	0.00	0.00	1.25	0.00	256	0.00	1.50	0.00	0.00	8-10
10/8/2018	9122	36	San Joaquin	20.90	20.70	700	1300	8.80	8.40	0.00	10.00	0.00	0.00	5.00	0.00	200	0.00	6.40	0.00	0.00	0-2
10/8/2018	9122	37	San Joaquin	21.00	20.90	1330	1530	11.10	10.80	0.00	2.50	0.00	0.00	1.75	0.00	200	0.00	1.60	0.00	0.00	4-6
10/8/2018	9607	127	Sacramento	20.10	20.60	930	1430	8.30	8.50	0.00	15.00	0.00	0.00	7.50	0.00	200	0.00	9.60	0.00	0.00	4-6
10/8/2018	9980	74	San Joaquin	20.80	21.40	900	1430	7.10	7.24	0.00	12.00	0.00	0.00	6.00	0.00	190	0.00	8.08	0.00	0.00	4-6
10/9/2018	0037	270	Solano	16.10	17.80	800	1130	8.20	8.60	0.00	7.50	0.00	0.00	5.00	0.00	240	0.00	4.00	0.00	0.00	2-4
10/9/2018	0037	284	Solano	18.50	18.80	1130	1330	8.40	8.00	0.00	5.00	0.00	0.00	2.50	0.00	240	0.00	2.67	0.00	0.00	2-4
10/9/2018	3548	132	Sacramento	18.40	19.60	930	1400	7.40	8.20	0.00	15.00	0.00	0.00	7.50	0.00	200	0.00	9.60	0.00	0.00	2-4
10/9/2018	8835	48	San Joaquin	20.10	20.10	1230	1500	5.10	5.20	0.00	0.00	4.00	0.00	2.50	0.00	172	0.00	0.00	2.98	0.00	8-10
10/9/2018	8835	49	San Joaquin	19.70	19.80	900	1230	6.10	5.80	0.00	10.00	0.00	0.00	5.00	0.00	172	0.00	7.44	0.00	0.00	6-8
10/9/2018	9011	13	San Joaquin	18.50	19.30	918	1545	6.00	7.50	0.00	11.25	0.00	0.00	6.00	0.00	256	0.00	5.63	0.00	0.00	6-8
10/9/2018	9122	28	San Joaquin	20.00	20.10	1330	1530	12.10	10.80	0.00	7.50	0.00	0.00	3.75	0.00	200	0.00	4.80	0.00	0.00	2-4
10/9/2018	9122	29	San Joaquin	19.90	19.60	700	1300	7.30	10.60	0.00	7.50	0.00	0.00	3.75	0.00	200	0.00	4.80	0.00	0.00	0-2
10/9/2018	9607	122	Sacramento	18.60	19.30	930	1500	7.60	7.90	0.00	15.00	0.00	0.00	7.50	0.00	200	0.00	9.60	0.00	0.00	4-6
10/9/2018	9980	47	San Joaquin	19.50	20.10	930	1445	7.45	7.75	0.00	1.00	0.00	0.00	0.50	0.00	190	0.00	0.67	0.00	0.00	4-6
10/10/2018	0006	79	Contra Costa	19.50	20.20	930	1330	8.30	8.72	0.00	4.00	0.00	0.00	2.00	0.00	192	0.00	2.67	0.00	0.00	2-4
10/10/2018	3420	13	San Joaquin	18.60	19.20	800	1500	8.90	8.10	0.00	12.50	0.00	0.00	6.00	0.00	130	0.00	12.31	0.00	0.00	0-2
10/10/2018	9011	216	Sacramento	17.70	19.80	930	1430	6.10	6.00	0.00	2.75	0.00	0.00	1.50	0.00	256	0.00	1.38	0.00	0.00	2-4
10/10/2018	9980	46	San Joaquin	19.60	21.30	900	1430	7.37	8.10	0.00	10.00	0.00	0.00	5.00	0.00	192	0.00	6.67	0.00	0.00	2-4
10/11/2018	3420	12	San Joaquin	18.50	18.90	830	1400	9.30	8.10	0.00	10.00	0.00	0.00	5.00	0.00	130	0.00	9.85	0.00	0.00	0-2

Date	Vessel ID	Site ID	County	Before Temp	After Temp	Time Arrived	Time Departed	DO Before	DO After	2,4-D	Glyphosate	Imazamox	Penoxsulam	Agridex	Competitor	Chem Rate	2,4-D Acres	Glyphosate Acres	Imazamox Acres	Penoxsulam Acres	Wind Speed
10/11/2018	9011	32	San Joaquin	17.70	20.40	840	1520	8.10	8.20	0.00	11.00	0.00	0.00	6.00	0.00	256	0.00	5.50	0.00	0.00	4-6
10/11/2018	9980	46	San Joaquin	19.00	20.20	900	1445	7.13	7.45	0.00	14.25	0.00	0.00	6.50	0.00	192	0.00	9.50	0.00	0.00	2-4
10/12/2018	9980	262	Solano	17.30	17.40	900	1530	10.30	9.70	0.00	15.00	0.00	0.00	7.50	0.00	192	0.00	10.00	0.00	0.00	6-8
10/15/2018	3420	6	San Joaquin	18.90	18.60	900	1430	7.10	8.70	0.00	7.50	0.00	0.00	3.50	0.00	130	0.00	7.38	0.00	0.00	0-2
10/15/2018	9980	300	San Joaquin	18.10	19.10	1100	1430	8.61	8.85	0.00	2.50	0.00	0.00	0.00	0.00	192	0.00	1.67	0.00	0.00	4-6
10/16/2018	0080	18	San Joaquin	19.00	19.60	800	1500	9.10	8.60	0.00	12.50	0.00	0.00	7.50	0.00	220	0.00	7.27	0.00	0.00	0-2
10/16/2018	3420	7	San Joaquin	18.10	18.30	830	1200	8.20	8.50	0.00	5.00	0.00	0.00	2.50	0.00	130	0.00	4.92	0.00	0.00	0-2
10/16/2018	3420	9	San Joaquin	18.60	19.30	1230	1530	8.60	8.40	0.00	7.50	0.00	0.00	3.50	0.00	130	0.00	7.38	0.00	0.00	2-4
10/16/2018	3548	216	Sacramento	18.90	19.40	1000	1400	8.10	9.00	0.00	7.50	0.00	0.00	3.00	0.00	200	0.00	4.80	0.00	0.00	2-4
10/16/2018	9011	203	San Joaquin	14.40	19.40	943	1345	8.10	8.70	0.00	7.50	0.00	0.00	2.50	0.00	200	0.00	4.80	0.00	0.00	2-4
10/16/2018	9980	74	San Joaquin	17.30	18.80	845	1445	7.55	7.42	0.00	12.50	0.00	0.00	6.00	0.00	192	0.00	8.33	0.00	0.00	4-6
10/17/2018	3420	10	San Joaquin	17.10	17.30	800	900	6.50	7.20	0.00	2.50	0.00	0.00	1.25	0.00	130	0.00	2.46	0.00	0.00	0-2
10/17/2018	3420	14	San Joaquin	17.60	18.10	1030	1330	8.90	9.10	0.00	3.00	0.00	0.00	1.50	0.00	130	0.00	2.95	0.00	0.00	0-2
10/17/2018	3548	18	San Joaquin	16.30	18.60	930	1430	8.90	9.40	0.00	15.00	0.00	0.00	7.00	0.00	200	0.00	9.60	0.00	0.00	2-4
10/17/2018	8835	77	San Joaquin	16.80	17.00	945	1430	5.63	6.01	0.00	0.00	5.00	0.00	0.00	2.50	128	0.00	0.00	5.00	0.00	2-4
10/17/2018	9011	18	Sacramento	16.10	19.00	930	1230	10.80	9.50	0.00	6.00	0.00	0.00	2.50	0.00	256	0.00	3.00	0.00	0.00	2-4
10/17/2018	9607	115	Contra Costa	18.40	19.00	1330	1530	7.80	8.00	0.00	5.00	0.00	0.00	2.50	0.00	200	0.00	3.20	0.00	0.00	4-6
10/17/2018	9980	300	San Joaquin	17.30	17.80	1045	1130	8.10	7.90	0.00	2.25	0.00	0.00	1.00	0.00	192	0.00	1.50	0.00	0.00	2-4
10/17/2018	9980	301	San Joaquin	17.20	17.50	830	1045	2.48	7.55	0.00	7.50	0.00	0.00	3.25	0.00	192	0.00	5.00	0.00	0.00	2-4
10/17/2018	9980	302	San Joaquin	17.80	18.10	1145	1245	7.80	8.45	0.00	3.75	0.00	0.00	1.50	0.00	192	0.00	2.50	0.00	0.00	2-4
10/17/2018	9980	304	San Joaquin	18.20	18.50	1300	1345	8.24	8.50	0.00	1.00	0.00	0.00	0.50	0.00	192	0.00	0.67	0.00	0.00	2-4
10/18/2018	0080	18	Sacramento	19.80	19.80	1230	1430	10.60	9.40	0.00	2.50	0.00	0.00	1.25	0.00	215	0.00	1.49	0.00	0.00	0-2
10/18/2018	0080	19	Sacramento	19.90	19.70	800	1200	12.60	8.30	0.00	7.50	0.00	0.00	3.75	0.00	215	0.00	4.47	0.00	0.00	0-2
10/18/2018	3420	66	San Joaquin	17.80	18.10	930	1200	7.50	8.10	0.00	4.00	0.00	0.00	2.00	0.00	130	0.00	3.94	0.00	0.00	0-2
10/18/2018	3420	67	San Joaquin	18.10	18.10	1230	1500	8.10	8.20	0.00	5.50	0.00	0.00	3.00	0.00	130	0.00	5.42	0.00	0.00	2-4
10/18/2018	8834	270	Solano	17.90	18.20	930	1400	8.60	8.00	0.00	7.50	0.00	0.00	5.00	0.00	240	0.00	4.00	0.00	0.00	2-4
10/18/2018	8835	49	San Joaquin	16.00	16.30	900	1300	2.00	2.20	0.00	9.00	0.00	0.00	4.50	0.00	192	0.00	6.00	0.00	0.00	2-4
10/18/2018	9122	311	Stanislaus	17.20	17.90	1200	1330	9.75	8.79	0.00	2.50	0.00	0.00	1.25	0.00	192	0.00	1.67	0.00	0.00	2-4
10/18/2018	9122	312	Stanislaus	16.80	17.10	1030	1145	9.40	9.81	0.00	2.50	0.00	0.00	1.25	0.00	192	0.00	1.67	0.00	0.00	2-4
10/19/2018	3420	102	Contra Costa	18.60	19.10	1200	1500	8.30	8.80	0.00	5.00	0.00	0.00	0.00	2.50	130	0.00	4.92	0.00	0.00	2-4
10/19/2018	3420	103	Contra Costa	18.40	18.60	930	1130	7.50	7.90	0.00	0.00	6.00	0.00	0.00	3.00	130	0.00	0.00	5.91	0.00	2-4
10/19/2018	9606	262	Solano	18.40	19.30	830	1330	7.60	7.80	0.00	15.00	0.00	0.00	7.50	0.00	240	0.00	8.00	0.00	0.00	2-4
10/19/2018	9607	262	Solano	18.40	19.30	830	1330	7.60	7.80	0.00	17.50	0.00	0.00	9.00	0.00	200	0.00	11.20	0.00	0.00	4-6
10/22/2018	0080	18	San Joaquin	19.10	19.10	800	1400	12.10	9.30	0.00	7.50	0.00	0.00	3.75	0.00	210	0.00	4.57	0.00	0.00	4-6
10/22/2018	3420	16	San Joaquin	16.30	16.80	730	1300	8.40	8.10	0.00	10.00	2.00	0.00	5.00	1.00	130	0.00	9.85	1.97	0.00	0-2
10/22/2018	3548	215	Sacramento	16.30	17.60	900	1300	9.40	8.90	0.00	2.50	0.00	0.00	1.50	0.00	200	0.00	1.60	0.00	0.00	0-2
10/22/2018	8835	48	San Joaquin	16.00	17.20	830	13	5.60	6.00	0.00	0.00	8.00	0.00	0.00	4.00	128	0.00	0.00	8.00	0.00	2-4
10/22/2018	9011	20	Sacramento	17.50	19.60	950	1500	6.50	7.50	0.00	10.00	0.00	0.00	5.00	0.00	256	0.00	5.00	0.00	0.00	6-8
10/22/2018	9980	700	Stanislaus	15.20	15.40	1000	1100	8.48	9.55	0.00	2.50	0.00	0.00	1.25	0.00	190	0.00	1.68	0.00	0.00	2-4
10/22/2018	9980	702	Stanislaus	15.40	15.50	1100	1145	9.22	8.94	0.00	0.00	2.00	0.00	0.00	1.00	190	0.00	0.00	1.35	0.00	2-4
10/22/2018	9980	703	Stanislaus	15.50	15.80	1145	1230	8.94	10.12	0.00	0.00	2.00	0.00	0.00	1.00	190	0.00	0.00	1.35	0.00	4-6
10/22/2018	9980	704	Stanislaus	15.80	16.00	1230	1330	10.12	9.45	0.00	0.00	3.00	0.00	0.00	1.50	190	0.00	0.00	2.02	0.00	4-6
10/22/2018	9980	705	Stanislaus	16.00	16.20	1330	1445	9.45	8.30	0.00	2.50	0.00	0.00	1.25	0.00	190	0.00	1.68	0.00	0.00	4-6
10/23/2018	3420	16	San Joaquin	16.30	16.70	800	1130	9.20	7.30	0.00	10.00	0.00	0.00	5.00	0.00	130	0.00	9.85	0.00	0.00	4-6
10/23/2018	3420	69	San Joaquin	16.70	16.80	1230	1330	7.20	6.80	0.00	2.50	0.00	0.00	1.25	0.00	130	0.00	2.46	0.00	0.00	6-8
10/23/2018	3548	219	Sacramento	16.60	17.80	930	1230	7.80	8.90	0.00	5.00	0.00	0.00	2.50	0.00	200	0.00	3.20	0.00	0.00	2-4
10/23/2018	8835	79	Alameda	16.30	16.10	930	1430	7.20	5.00	0.00	0.00	7.00	0.00	0.00	3.50	128	0.00	0.00	7.00	0.00	2-4
10/23/2018	9339	100	San Joaquin	16.50	17.10	900	1330	7.58	7.90	0.00	15.00	0.00	0.00	7.50	0.00	240	0.00	8.00	0.00	0.00	0-2
10/23/2018	9980	78	San Joaquin	15.90	16.70	930	1400	8.48	0.00	0.00	0.00	8.00	0.00	0.00	4.00	190	0.00	0.00	5.39	0.00	4-6
10/24/2018	0080	28	San Joaquin	17.40	17.30	1000	1500	9.00	8.90	0.00	5.00	0.00	0.00	2.50	0.00	256	0.00	2.50	0.00	0.00	6-8

Date	Vessel ID	Site ID	County	Before Temp	After Temp	Time Arrived	Time Departed	DO Before	DO After	2,4-D	Glyphosate	Imazamox	Penoxsulam	Agridex	Competitor	Chem Rate	2,4-D Acres	Glyphosate Acres	Imazamox Acres	Penoxsulam Acres	Wind Speed
10/24/2018	3420	8	San Joaquin	16.50	16.60	1100	1500	7.10	7.90	0.00	5.00	0.00	0.00	2.50	0.00	260	0.00	2.46	0.00	0.00	0-2
10/24/2018	3420	9	San Joaquin	16.10	16.30	800	1030	8.60	7.50	0.00	5.00	0.00	0.00	2.50	0.00	260	0.00	2.46	0.00	0.00	0-2
10/24/2018	8835	80	San Joaquin	17.80	17.90	930	1430	9.25	6.85	0.00	0.00	6.00	0.00	0.00	3.00	128	0.00	0.00	6.00	0.00	2-4
10/24/2018	9011	205	San Joaquin	15.60	17.90	932	1500	0.20	0.10	0.00	5.00	0.00	0.00	2.00	0.00	256	0.00	2.50	0.00	0.00	2-4
10/24/2018	9980	80	San Joaquin	17.80	18.40	930	1430	9.45	8.35	0.00	0.00	5.00	0.00	0.00	2.50	190	0.00	0.00	3.37	0.00	2-4
10/25/2018	0006	77	San Joaquin	17.80	16.90	900	1430	6.20	6.50	0.00	0.00	10.00	0.00	0.00	4.50	128	0.00	0.00	10.00	0.00	2-4
10/25/2018	0037	38	San Joaquin	16.80	17.00	1000	1430	8.40	8.40	0.00	5.00	0.00	0.00	2.50	0.00	256	0.00	2.50	0.00	0.00	4-6
10/25/2018	0080	32	San Joaquin	17.90	17.90	800	1300	10.60	7.30	0.00	5.00	0.00	0.00	2.50	0.00	230	0.00	2.78	0.00	0.00	0-2
10/25/2018	3420	76	San Joaquin	16.60	16.80	1100	1500	7.50	8.10	0.00	0.00	4.00	0.00	0.00	2.00	260	0.00	0.00	1.97	0.00	2-4
10/25/2018	3420	77	San Joaquin	16.30	16.50	830	1030	7.00	7.30	0.00	0.00	2.00	0.00	0.00	1.00	260	0.00	0.00	0.98	0.00	0-2
10/25/2018	9011	205	Sacramento	16.10	20.10	930	1430	0.10	1.70	0.00	2.00	0.00	0.00	1.00	0.00	256	0.00	1.00	0.00	0.00	4-6
10/26/2018	3420	76	San Joaquin	16.20	16.60	830	1430	7.90	8.30	0.00	0.00	10.00	0.00	0.00	5.00	260	0.00	0.00	4.92	0.00	0-2
10/26/2018	9011	74	San Joaquin	18.30	19.50	900	1500	5.90	2.60	0.00	0.00	24.00	0.00	0.00	10.00	192	0.00	0.00	16.00	0.00	2-4
10/26/2018	9607	76	San Joaquin	16.50	17.00	830	1430	7.30	7.60	0.00	20.00	0.00	0.00	10.00	0.00	200	0.00	12.80	0.00	0.00	4-6
10/26/2018	MERCED	413	Merced	17.50	20.10	840	1340	7.80	7.30	0.00	0.02	0.00	0.00	0.01	0.00	96	0.00	0.03	0.00	0.00	0-2
10/29/2018	0037	267	Solano	15.90	15.70	900	1330	8.70	8.50	0.00	15.00	0.00	0.00	8.00	0.00	240	0.00	8.00	0.00	0.00	4-6
10/29/2018	3420	13	San Joaquin	15.90	16.40	830	1230	8.40	8.80	0.00	0.00	4.00	0.00	0.00	2.00	260	0.00	0.00	1.97	0.00	4-6
10/29/2018	3548	214	Sacramento	16.30	16.70	800	1100	8.60	8.90	0.00	6.00	0.00	0.00	3.00	0.00	200	0.00	3.84	0.00	0.00	2-4
10/29/2018	3548	215	Sacramento	16.80	17.20	1115	1315	9.10	9.40	0.00	4.00	0.00	0.00	2.00	0.00	200	0.00	2.56	0.00	0.00	4-6
10/29/2018	9606	77	San Joaquin	17.30	17.80	1000	1500	7.30	7.10	0.00	12.50	0.00	0.00	7.50	0.00	220	0.00	7.27	0.00	0.00	6-8
										0.00	786.27	112.00	0.00	386.76	54.00		0.00	533.72	86.17	0.00	

Table B-9. November 2018 Herbicide and Adjuvant Use

Date	Vessel ID	Site ID	County	Before Temp	After Temp	Time Arrived	Time Departed	DO Before	DO After	2,4-D	Glyphosate	Imazamox	Penoxsulam	Agridex	Competitor	Chem Rate	2,4-D Acres	Glyphosate Acres	Imazamox Acres	Penoxsulam Acres	Wind Speed
11/1/2018	0037	267	Solano	15.00	15.40	900	1330	10.80	10.00	0.00	15.00	0.00	0.00	7.50	0.00	240	0.00	8.00	0.00	0.00	2-4
11/1/2018	0080	36	San Joaquin	16.70	17.20	1000	1430	9.10	9.30	0.00	10.00	0.00	0.00	5.00	0.00	256	0.00	5.00	0.00	0.00	4-6
11/1/2018	3420	67	San Joaquin	16.40	16.60	1030	1200	7.90	8.30	0.00	0.00	3.00	0.00	0.00	1.50	260	0.00	0.00	1.48	0.00	0-2
11/1/2018	3420	68	San Joaquin	16.50	16.70	1230	1500	8.10	8.40	0.00	0.00	5.00	0.00	0.00	2.50	260	0.00	0.00	2.46	0.00	0-2
11/1/2018	9011	200	San Joaquin	15.50	17.20	900	1330	8.80	9.80	0.00	5.00	0.00	0.00	2.00	0.00	256	0.00	2.50	0.00	0.00	0-2
11/2/2018	0055	46	San Joaquin	15.30	15.90	930	1400	7.83	7.01	0.00	15.00	0.00	0.00	7.50	0.00	240	0.00	8.00	0.00	0.00	0-2
11/2/2018	9606	262	Solano	14.50	14.20	900	1430	2.00	7.40	0.00	12.50	0.00	0.00	6.50	0.00	240	0.00	6.67	0.00	0.00	2-4
11/5/2018	0037	267	Solano	17.10	17.00	930	1130	8.90	8.60	0.00	5.00	0.00	0.00	2.00	0.00	240	0.00	2.67	0.00	0.00	6-8
11/5/2018	3548	249	Sacramento	16.30	17.50	1000	1330	9.30	9.80	0.00	7.50	0.00	0.00	3.50	0.00	200	0.00	4.80	0.00	0.00	4-6
11/5/2018	9606	76	San Joaquin	16.10	16.70	900	1400	9.20	8.19	0.00	13.50	0.00	0.00	6.50	0.00	200	0.00	8.64	0.00	0.00	0-2
11/6/2018	3420	61	San Joaquin	15.90	16.30	930	1430	7.30	8.40	0.00	0.00	1.00	0.00	0.00	0.50	260	0.00	0.00	0.49	0.00	6-8
11/6/2018	9011	205	San Joaquin	18.80	16.00	1209	1443	1.60	0.10	0.00	11.00	0.00	0.00	5.00	0.00	256	0.00	5.50	0.00	0.00	2-4
11/6/2018	9606	75	San Joaquin	15.20	16.10	840	1410	9.16	7.12	0.00	15.00	0.00	0.00	6.50	0.00	200	0.00	9.60	0.00	0.00	2-4
11/9/2018	3420	75	San Joaquin	15.60	16.10	900	1500	8.10	8.90	0.00	0.00	7.00	0.00	3.50	0.00	260	0.00	0.00	3.45	0.00	0-2
11/13/2018	0006	45	San Joaquin	10.60	11.00	900	1430	11.33	10.40	0.00	0.00	1.75	0.00	0.00	2.00	192	0.00	0.00	1.17	0.00	2-4
11/13/2018	3548	8	San Joaquin	14.20	14.10	1330	1445	10.80	11.00	0.00	5.00	0.00	0.00	2.50	0.00	200	0.00	3.20	0.00	0.00	0-2
11/13/2018	3738	20	Sacramento	16.70	16.80	900	1330	9.10	8.70	0.00	5.00	0.00	0.00	2.50	0.00	225	0.00	2.84	0.00	0.00	0-2
11/13/2018	8834	267	Solano	12.50	12.40	1100	1300	9.40	9.00	0.00	3.00	0.00	0.00	2.00	0.00	240	0.00	1.60	0.00	0.00	2-4
11/13/2018	9011	286	San Joaquin	14.00	14.20	1030	1410	7.50	6.90	0.00	3.50	0.00	0.00	2.50	0.00	256	0.00	1.75	0.00	0.00	2-4
11/13/2018	9122	300	San Joaquin	14.20	14.80	930	1430	9.41	8.90	0.00	1.50	0.00	0.00	0.75	0.00	190	0.00	1.01	0.00	0.00	2-4
11/13/2018	9606	76	San Joaquin	13.20	14.10	900	1500	10.21	9.31	0.00	10.00	0.00	0.00	5.00	0.00	200	0.00	6.40	0.00	0.00	0-2
11/14/2018	0006	49	San Joaquin	12.10	12.00	900	1530	6.70	6.90	0.00	9.00	0.00	0.00	5.00	0.00	192	0.00	6.00	0.00	0.00	0-2
11/14/2018	8834	267	Solano	10.80	11.50	900	1400	9.70	9.00	0.00	13.00	0.00	0.00	5.50	0.00	240	0.00	6.93	0.00	0.00	2-4
11/14/2018	9011	205	San Joaquin	14.00	14.80	903	1505	1.20	1.40	0.00	10.00	0.00	0.00	3.00	0.00	256	0.00	5.00	0.00	0.00	0-2
11/14/2018	9606	74	San Joaquin	13.60	13.50	900	1500	7.18	8.10	0.00	13.50	0.00	0.00	5.00	0.00	200	0.00	8.64	0.00	0.00	0-2
11/15/2018	3420	14	San Joaquin	12.10	14.10	830	1530	6.40	8.60	0.00	0.00	6.00	0.00	0.00	3.00	260	0.00	0.00	2.95	0.00	0-2
11/15/2018	3548	249	Sacramento	10.20	11.10	930	1200	10.80	10.40	0.00	1.78	0.00	0.00	0.89	0.00	200	0.00	1.14	0.00	0.00	0-2
11/15/2018	3548	250	Sacramento	10.20	11.10	1023	1023	10.80	10.40	0.00	3.22	0.00	0.00	1.61	0.00	200	0.00	2.06	0.00	0.00	0-2
11/19/2018	3548	133	Solano	14.80	14.60	930	1300	9.10	9.60	0.00	10.00	0.00	0.00	5.00	0.00	200	0.00	6.40	0.00	0.00	2-4
11/20/2018	9606	262	Solano	9.20	9.50	900	1330	7.80	7.60	0.00	13.00	0.00	0.00	10.00	0.00	240	0.00	6.93	0.00	0.00	2-4
11/26/2018	3420	252	Solano	11.50	12.50	1000	1230	8.10	9.30	0.00	0.00	0.50	0.00	0.00	0.25	260	0.00	0.00	0.25	0.00	0-2
11/26/2018	3548	249	Sacramento	13.00	13.40	900	1030	11.80	11.00	0.00	2.50	0.00	0.00	1.00	0.00	200	0.00	1.60	0.00	0.00	2-4
11/26/2018	8834	134	Contra Costa	11.70	11.90	1030	1330	8.00	7.90	0.00	3.50	0.00	0.00	1.75	0.00	215	0.00	2.08	0.00	0.00	0-2
11/26/2018	9012	134	Contra Costa	11.80	11.80	1030	1300	7.00	7.10	0.00	5.00	0.00	0.00	2.00	0.00	256	0.00	2.50	0.00	0.00	2-4
11/26/2018	9980	76	San Joaquin	12.80	13.60	900	1100	8.25	8.35	0.00	7.50	0.00	0.00	3.00	0.00	190	0.00	5.05	0.00	0.00	2-4
11/26/2018	9980	77	San Joaquin	13.70	13.80	1100	1500	2.90	7.70	0.00	10.00	0.00	0.00	0.00	0.00	190	0.00	6.74	0.00	0.00	2-4
11/27/2018	3420	51	San Joaquin	11.90	12.50	900	1130	7.20	8.90	0.00	0.00	3.00	0.00	0.00	1.50	260	0.00	0.00	1.48	0.00	0-2
11/27/2018	9011	259	Yolo	12.20	12.20	1000	1030	9.40	9.50	0.00	1.00	0.00	0.00	0.50	0.00	256	0.00	0.50	0.00	0.00	2-4
11/27/2018	9011	265	Solano	12.10	12.10	900	930	9.30	9.50	0.00	1.00	0.00	0.00	0.50	0.00	256	0.00	0.50	0.00	0.00	2-4
11/27/2018	9606	72	San Joaquin	11.90	12.60	900	1350	7.21	8.11	0.00	10.00	0.00	0.00	5.00	0.00	200	0.00	6.40	0.00	0.00	0-2
11/27/2018	9980	73	San Joaquin	13.00	13.70	930	1400	8.41	8.22	0.00	10.00	0.00	0.00	4.25	0.00	190	0.00	6.74	0.00	0.00	2-4
11/30/2018	3420	72	San Joaquin	13.10	13.30	900	1130	8.10	8.30	0.00	7.50	0.00	0.00	3.50	0.00	260	0.00	3.69	0.00	0.00	2-4
11/30/2018	3420	291	San Joaquin	13.30	14.10	1130	1400	8.30	8.80	0.00	5.00	0.00	0.00	2.50	0.00	260	0.00	2.46	0.00	0.00	2-4
11/30/2018	9606	73	San Joaquin	10.90	11.50	1050	1350	7.20	7.52	0.00	5.00	0.00	0.00	2.50	0.00	200	0.00	3.20	0.00	0.00	2-4
11/30/2018	9606	75	San Joaquin	11.20	11.70	820	1035	8.12	9.14	0.00	5.00	0.00	0.00	2.50	0.00	200	0.00	3.20	0.00	0.00	0-2
										0.00	284.00	27.25	0.00	135.75	11.25		0.00	165.95	13.72	0.00	

APPENDIX C

2018 Treatment Count Per Site

2018 FAV Treatment Count (Glyphosate, 2,4-D, and Imazamox)																				As of 11/30/18	
Site ↓	Count ↓	Site ↓	Count ↓	Site ↓	Count ↓	Site ↓	Count ↓	Site ↓	Count ↓	Site ↓	Count ↓	Site ↓	Count ↓	Site ↓	Count ↓	Site ↓	Count ↓	Site ↓	Count ↓	Site ↓	Count ↓
1	0	35	0	74	23	101B	2	135	0	222	0	255	0	290B	0	411	2	521	4	903	0
2	0	36	6	75	6	102	1	136	0	223	0	256A	0	291	3	412	11	522	2	904	0
3	0	37	7	76	18	103A	1	137	0	224	0	256B	0	300	9	413	6	523	1	905	0
4	0	38	6	77	11	103B	0	138	0	225	0	257A	0	301	4	414	0	524	1	906	2
5	0	39	3	78	1	104A	0	139	0	226	0	257B	0	302	7	414A	0	525	0	907	2
6	5	40	3	79	4	104B	0	140	0	230	0	258A	0	303	7	415	0	526	0	908	2
7	2	41	1	80	1	105	0	141	1	231	0	258B	0	304	5	416	0	527	0	909A	0
8	9	42	2	81	1	106	0	171	0	232	0	259	2	305	0	417	0	528	1	909B	8
9	7	43	0	82	0	107	3	173	1	233	0	260	0	306	0	418	0	529	3	910A	0
10	2	44	0	83A	0	108	2	174	0	234	0	261	0	307	0	419	0	530	0	910B	6
11	0	45	2	83B	0	109	7	175	0	235	0	262	11	308	0	420	0	532	0	911A	0
12	5	46	4	84A	1	110	4	176	5	236	0	263	0	309	0	421	0	533	0	911B	1
13	5	47	6	84B	0	111	0	200	2	237	0	264	0	310	0	422	0	534	0	912	0
14	16	48	12	85A	0	112	8	201	2	238	0	265	2	311	1	423	0	535	0	913	0
15	9	49	16	85B	0	113	1	202	2	239	0	266	0	312	1	424	0	536	0	914	0
16	3	50	1	86A	0	114	0	203	8	240A	0	267	8	313	1	425	0	537	0	915	0
17A	0	51	1	86B	0	115	3	204	1	240B	1	268	0	314	0	426	0	600	0	916	0
17B	0	52	1	87A	0	116	4	205	9	241	0	269	0	315	0	427	0	700	1	917	0
18A	4	53	0	87B	0	117	3	206	1	242	0	270	3	316	0	500	0	701	0	918	0
18B	3	54	0	88	0	118	0	207	0	243	0	271	0	317	2	501	0	702	1	919	0
19A	3	55	0	89A	0	119A	0	208	0	244	0	272	2	318	2	502	0	703	1	920	0
19B	0	56	4	89B	0	119B	0	209A	1	245	0	273	0	319	2	503	0	704	1	921	0
20	14	57	2	90A	0	120A	0	209B	0	246A	0	274	0	320	0	504	0	705	1	922	0
21A	0	58	5	90B	0	120B	0	210A	1	246B	0	275	0	321	1	505	0	706	1	923	0
21B	0	59	0	91A	2	121A	1	210B	0	247A	0	276	0	322	1	506	1	707	1	924	0
22	0	60	0	91B	0	121B	0	211A	1	247B	0	277	0	323	1	507	1	708	0	925	0
23A	0	61	4	92A	3	122	1	211B	0	248A	0	278	2	324	0	508	2	709	0	926	0
23B	0	62	4	92B	3	123	0	212A	1	248B	0	279	0	325	0	509	1	710	0	927	0
24A	0	63	0	93	0	124	1	212B	0	249A	0	280	3	400	1	510	1	711	0	928	0
24B	0	64	0	94	0	125	0	213A	0	249B	3	281	1	401	1	511	1	712	0	929	0
25	0	65	9	95	0	126	2	213B	0	250A	0	282	2	402	1	512	2	713	3	SUMMARY	
26	10	66	1	96	1	127	4	214	4	250B	1	283	0	403	0	513	2	714	1	Sites Treated	
28	9	67	2	97	1	128	5	215	10	251A	0	284	1	404	3	514	1	715	0	190	
29	2	68	3	98A	0	129	1	216	4	251B	1	285	0	405	3	515	1	716	0	Count	
30	1	69	2	98B	0	130	3	217	4	252A	0	286	4	406	0	516	0	717	0	688	
31	3	70	0	99A	1	131	0	218	0	252B	4	287	0	407	3	517	1	718	0	Tidal	
32	14	71	0	99B	1	132	1	219	4	253A	0	288	0	408	11	518	2	900	0	129	513
33	2	72	3	100	2	133	9	220	0	253B	1	289	0	409	11	519	2	901	0	Riverine	
34	2	73	2	101A	3	134	3	221	1	254	0	290A	0	410	10	520	6	902	0	61	175
Less Treatments			→→→							→→→								→→→		More Treatments	

APPENDIX D

NPDES Monitoring and Laboratory Data

Monitoring Results – Site 122, Donlon Island

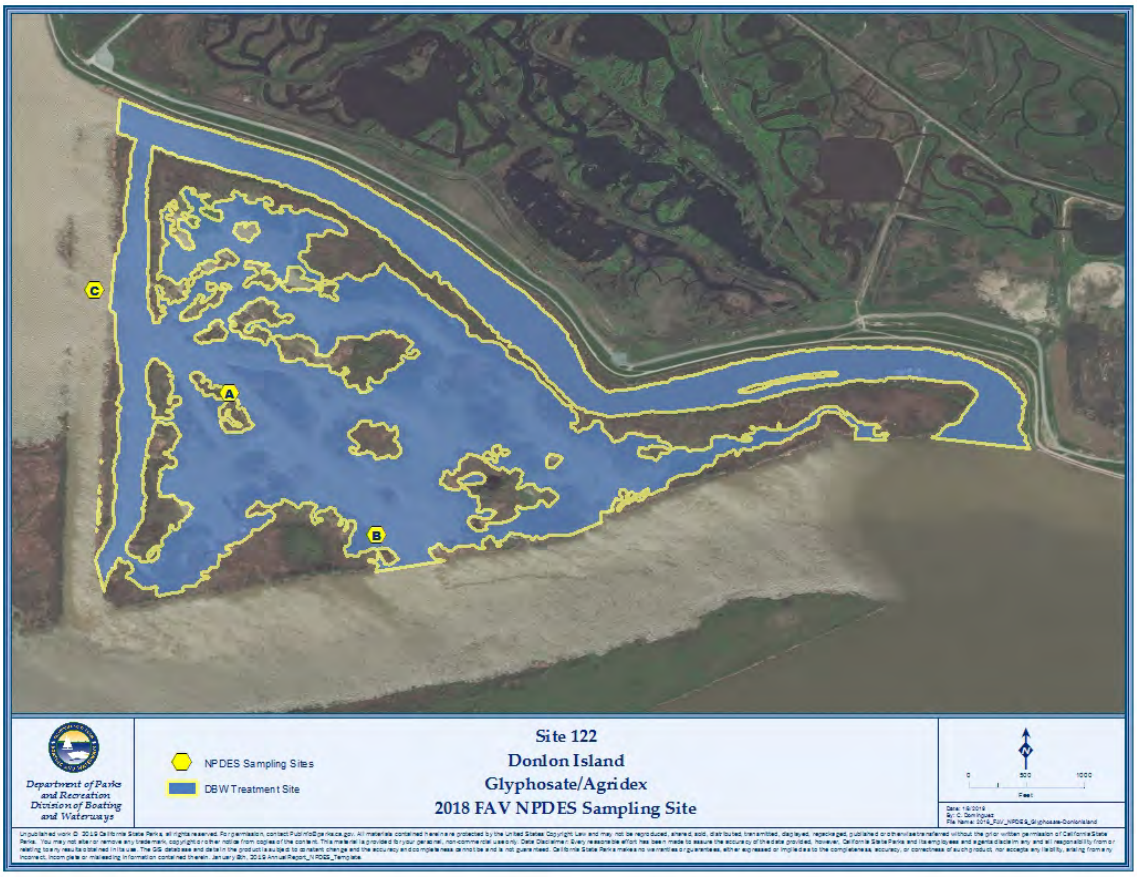
Glyphosate Residue

Sample Location	Sample ID	Date Sample Taken	Date Sample Received	Glyphosate (ppb) via HPLC
1C	H122-111418-2	11/14/2018	11/15/2018	ND
1A	H122-111418-2	11/14/2018	11/15/2018	ND
2B	H122-111418-2	11/14/2018	11/15/2018	ND
3C	H122-112018-2	11/20/2018	11/21/2018	ND
3A	H122-112018-3	11/20/2018	11/21/2018	ND
3B	H122-112018-5	11/20/2018	11/21/2018	ND

ND = No Detection/Non-Detect

Water Quality Data

Sample Location	Sample ID	Date	UTM Easting	UTM Northing	Time	Water Temp (ºC)	Conduct-ivity (mS/cm)	Salinity (ppt)	DO (mg/L)	pH	Turbidity (NTU)	Tide Cycle
1C	H122-111418-2	11/14/2018	606648	4210340	1034	14.39	6528	-	7.98	8.33	24.2	High Slack
1A	H122-111418-2	11/14/2018	607235	4209719	1011	13.98	4536	-	8.12	8.33	20.0	High Slack
2B	H122-111418-2	11/14/2018	607244	4209705	1313	14.52	5949	-	8.61	8.42	23.9	High Slack
3C	H122-112018-2	11/20/2018	606883	4210193	1054	13.15	7050	-	8.11	8.31	26.5	Flood
3A	H122-112018-3	11/20/2018	606933	4210072	1104	13.27	6556	-	8.05	8.11	25.5	Flood
3B	H122-112018-5	11/20/2018	607243	4209702	1122	13.02	6038	-	8.66	8.38	23.8	Flood



Monitoring Results – Site 124, Sherman Lake

Glyphosate Residue

Sample Location	Sample ID	Date Sample Taken	Date Sample Received	Glyphosate (ppb) via HPLC
1C	H-124-111418-2	11/14/2018	11/15/2018	ND
1A	H-124-111418-3	11/14/2018	11/15/2018	ND
2B	H-124-111418-5	11/14/2018	11/15/2018	ND
3C	H-124-112018-2	11/20/2018	11/21/2018	ND
3A	H-124-112018-3	11/20/2018	11/21/2018	ND
3B	H-124-112018-5	11/20/2018	11/21/2018	ND

Water Quality Data

Sample Location	Sample ID	Date	UTM Easting	UTM Northing	Time	Water Temp (ºC)	Conduct-ivity (mS/cm)	Salinity (ppt)	DO (mg/L)	pH	Turbidity (NTU)	Tide Cycle
1C	H-124-111418-2	11/14/2018	605299	4210030	1220	13.06	5187	-	10.66	8.53	19.3	Ebb
1A	H-124-111418-3	11/14/2018	605276	4210095	1203	12.68	5051	-	7.32	8.44	27.0	Ebb
2B	H-124-111418-5	11/14/2018	605758	4210312	1341	12.15	4849	-	10.00	8.29	21.9	Ebb
3C	H-124-112018-2	11/20/2018	605305	4209977	1205	12.91	7379	-	9.93	8.61	25.9	Flood
3A	H-124-112018-3	11/20/2018	605260	4210538	1219	13.36	6880	-	9.05	8.53	25.0	Flood
3B	H-124-112018-5	11/20/2018	605762	4210316	1238	12.52	7074	-	10.47	8.66	27.5	Flood

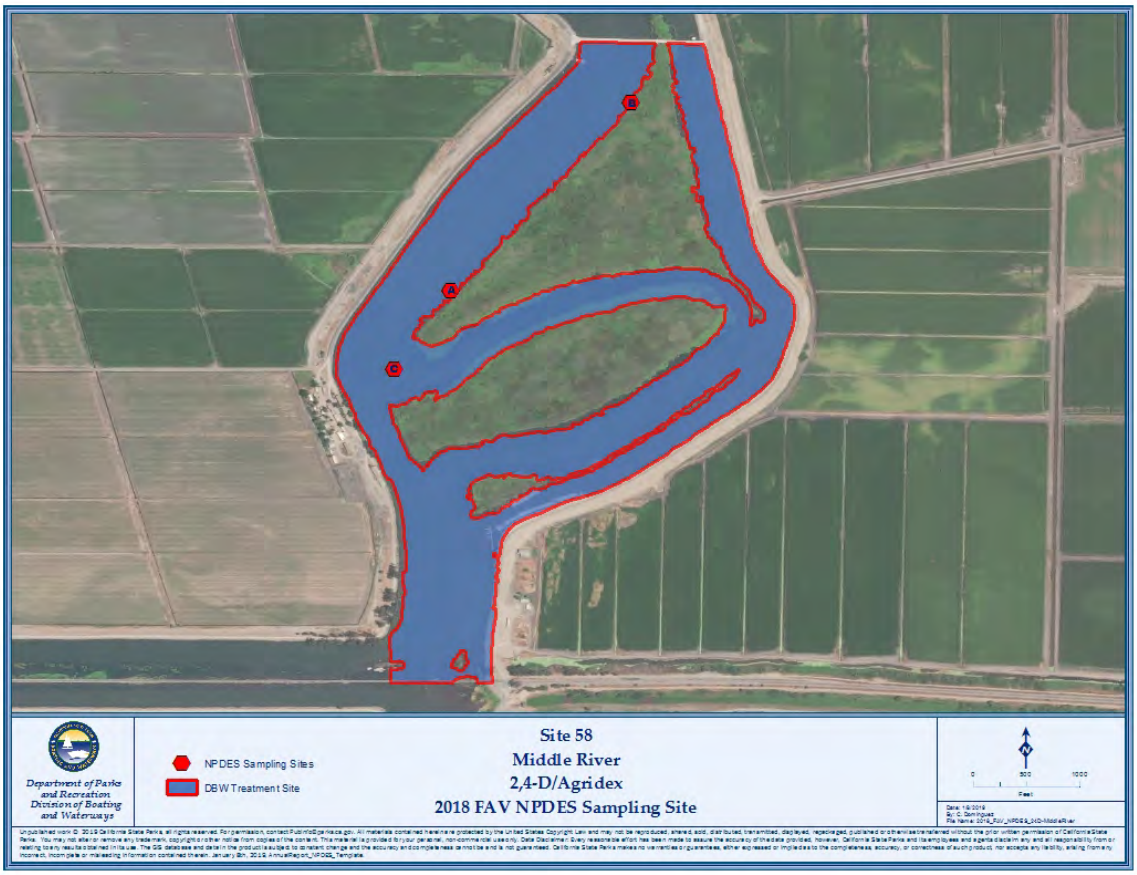
Monitoring Results – Site 58, Middle River

2,4-D Residue

Sample Location	Sample ID	Date Sample Taken	Date Sample Received	2,4-D (ppb)
1C	H58-09052018-2	9/5/2018	9/5/2018	ND
1A	H58-09052018-3	9/5/2018	9/5/2018	ND
2B	H58-09052018-5	9/5/2018	9/5/2018	ND
3C	H58-09122018-2	9/12/2018	9/13/2018	ND
3A	H58-09122018-3	9/12/2018	9/13/2018	ND
3B	H58-09122018-5	9/12/2018	9/13/2018	ND

Water Quality Data

Sample Location	Sample ID	Date	UTM Easting	UTM Northing	Time	Water Temp (ºC)	Conduct-ivity (mS/cm)	Salinity (ppt)	DO (mg/L)	pH	Turbidity (NTU)	Tide Cycle
1C	H58-09052018-2	9/5/2018	628796	4201053	1055	22.37	337	0.16	8.04	8.02	5.0	Flood
1A	H58-09052018-3	9/5/2018	628921	4201280	1115	22.51	338	0.16	8.17	7.87	3.1	Flood
2B	H58-09052018-5	9/5/2018	629323	4201827	1307	22.74	337	0.16	8.80	8.03	3.1	Flood
3C	H58-09122018-2	9/12/2018	628801	4201054	1505	23.13	364.5	-	6.99	7.84	15.3	Ebb
3A	H58-09122018-3	9/12/2018	628922	4201282	1520	23.87	366.3	-	9.36	8.56	17.6	Ebb
3B	H58-09122018-5	9/12/2018	629322	4201827	1543	23.81	362.9	-	8.91	8.50	17.7	Ebb



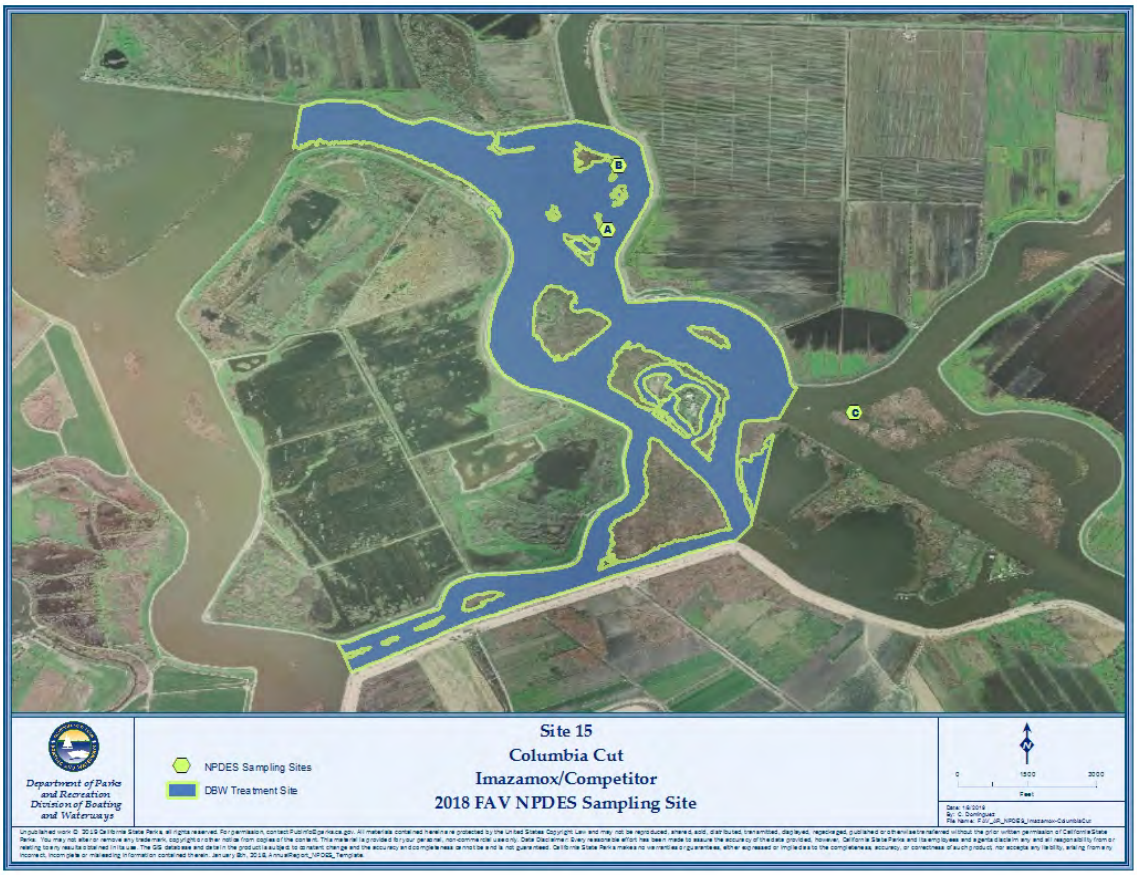
Monitoring Results – Site 15, Little Venice Island/Little Connection Slough

Imazamox Residue

Sample Location	Sample ID	Date Sample Taken	Date Sample Received	2,4-D (ppb)
1C	H15-09192018-2	9/19/2018	9/20/2018	ND
1A	H15-09192018-3	9/19/2018	9/20/2018	ND
2B	H15-09192018-5	9/19/2018	9/20/2018	ND
3C	H15-09262018-2	9/26/2018	9/27/2018	ND
3A	H15-09262018-3	9/26/2018	9/27/2018	ND
3B	H15-09262018-5	9/26/2018	9/27/2018	ND

Water Quality Data

Sample Location	Sample ID	Date	UTM Easting	UTM Northing	Time	Water Temp (ºC)	Conduct-ivity (mS/cm)	Salinity (ppt)	DO (mg/L)	pH	Turbidity (NTU)	Tide Cycle
1C	H15-09192018-2	9/19/2018	632975	4210983	0900	20.82	257.3	-	6.85	8.24	19.6	Ebb
1A	H15-09192018-3	9/19/2018	631673	4212165	0846	20.62	259.6	-	6.47	8.21	19.9	Ebb
2B	H15-09192018-5	9/19/2018	631721	4212585	1159	20.75	183.8	-	7.79	8.23	19.3	Low Slack
3C	H15-09262018-2	9/26/2018	631597	4211905	0927	20.79	274.9	-	7.03	8.21	16.4	Ebb
3A	H15-09262018-3	9/26/2018	631665	4212160	1005	20.64	216.1	-	6.91	8.15	20.2	Ebb
3B	H15-09262018-5	9/26/2018	631768	4212589	1023	20.74	247.4	-	7.01	8.15	19.2	Ebb



APPENDIX E

Weekly Notification Flyer

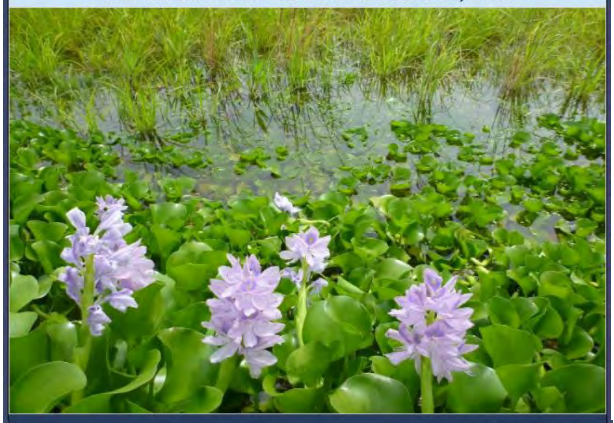
Weekly notification flyers (see example below) are distributed via email to marina operators, and other interested individuals, entities, and agencies for areas in the Delta where herbicide treatments are being implemented to control floating and submersed aquatic vegetation.

FLOATING AQUATIC VEGETATION CONTROL PROGRAM

Water Hyacinth (*Eichhornia crassipes*),
South American spongeplant (*Limnobium laevigatum*),
Uruguay water Primrose (*Ludwigia hexapetala*), and
Alligatorweed (*Alternanthera philoxeroides)*

California Department of Parks and Recreation
Division of Boating and Waterways
Aquatic Invasive Plant Control Program (AIPCP)

Treatments for March 12 thru March 16, 2018



Herbicide treatment of invasive floating aquatic vegetation will begin on March 12, 2018 in various areas of the Sacramento -San Joaquin Delta. For more information see the *Public Notice*.

Treatment Sites							
ALA	CC	MER	SAC	SJ	STAN	SOL	YOLO
79	83a, 84a, 85b, 86b, 87a, 88, 89a, 90a, 91a, 92a, 93-97, 110, 111, 115-117, 173, 174		18a, 20, 209a-258b, 285, 286	25-53, 62, 70-78, 81, 82, 83b, 84b, 85a, 86a, 87b, 89b, 90b, 91b, 92b, 203-206, 209b-213b			

View Larger Image

"Treatment sites and schedules are subject to change based on regulatory requirements, weather conditions, plant growth and movement, waterway traffic, listed fish presence surveys, and other conditions."

- Spraying will be conducted during the hours of 7am to 4pm weekly, Monday thru Friday.
- Herbicide applications during the treatment period will utilize Glyphosate (Roundup Custom) and Imazamox (Clearcast)

Treatment Period:

Area 2-4: Mar. 1, 2018 - Nov. 30, 2018
Area 1: June 1, 2018 - Nov. 30, 2018

County References:

ALA - Alameda; CC - Contra Costa;
MER - Merced; SAC - Sacramento; SJ - San Joaquin;
STAN - Stanislaus; SOL - Solano; YOLO - Yolo

In 2017, the Division of Boating and Waterways treated approximately 3,025* acres of water hyacinth, spongeplant and/or water primrose.

** Data are preliminary and subject to change.*

Detailed Site Information

Northern Treatment Site Map

Southern Site Map

Fish Presence Summary

Visit Our Website

DIVISION OF BOATING AND WATERWAYS
ONE CAPITOL MALL, SUITE 500
SACRAMENTO, CA 95814

1-888-326-2822 ais@parks.ca.gov

APPENDIX F

FAV Species Controlled by DBW in 2018

For more information, visit our website at dbw.parks.ca.gov.

Floating Aquatic Vegetation Approved for Control (2018 Season)

Water hyacinth — *Floating*

Eichhornia crassipes

Image Credit: Michael Kwong, DBW

Description

- Free-floating perennial, sometimes rooted in mud
- Shiny leaves and spongy stalks
- Lavender to white flowers with a yellow "eye-spot"
- When non-flowering and intermediate-aged, can be confused with South American spongeplant
- Native to South America

Growth Period: spring - late fall; flowers June - October

Habitat: ponds, sloughs, channels, canals, streams, rivers, lakes

Control Methods Currently Used By DBW:

- Herbicide
- Mechanical Removal
- Hand Removal

Uruguay water primrose — *Floating*

Ludwigia hexapetala

Image Credits: Left: Hoffman, Right: Janet Zipser Zipkin

Description

- Floating to emergent perennial
- Leaves and stems creep onto land, float on the water surface, or grow upright; upright stems are slightly hairy
- Oval-shaped (younger) to willow-like (more mature) leaves
- Bright, showy yellow flowers
- Native to South America

Growth Period: spring - late fall; flowers May - December

Habitat: slow-flowing rivers, lake and reservoir margins, and in the shallow waters of canals and floodplains

Control Methods Currently Used By DBW:

- Herbicide
- Mechanical Removal

South American spongeplant — *Floating*

Limnobium laevigatum

Image Credits: Left: Michael Kwong, DBW; Right: Lars Anderson

Description

- Floating to rooted perennial
- Thick, spongy, floating ovate to spatula-shaped leaves; honeycomb-like spongy tissue on lower surfaces
- Juveniles develop into mature clumps up to 50 cm (~20 in) tall
- Small white flowers
- More mature plants can be confused with water hyacinth
- Native to Central and South America

Growth Period: spring - late fall; flowers June - September

Habitat: ponds, sloughs, channels, canals, streams, lakes

Control Methods Currently Used By DBW:

- Herbicide
- Mechanical Removal
- Hand Removal

Parks DBW Rev 04112018

Alligatorweed
Alternanthera philoxeroides

Image Credit: Top: Jose Martinez, DBW; Bottom: Michael Kwong, DBW

Description

- Aquatic to terrestrial perennial
- Aquatic form has hollow stems above and below the water, while terrestrial form has solid stems
- Lance-like to oval-like leaves that narrow at the base
- Leaves have distinctive midrib
- Pleasantly fragrant pearly white flowers
- Can be confused with water primrose when not in bloom
- Native to South America

Growth Period: rapid growth in summer, survives cold winters without long periods of frost; flowers June - October

Habitat: shallow water in ditches, marshes, pond margins, and slow-moving waterways. May also be found terrestrially in wet soils

APPENDIX G

FAV Species Not Approved for Control by DBW in 2018

For more information, visit our website at dbw.parks.ca.gov.

Aquatic Vegetation Not Approved for Control (2018 Season)

Floating pennywort
Hydrocotyle ranunculoides

Image Credit: Michael Kwong, DBW

Description

- Floating to terrestrial perennial with branched, creeping stems
- Bare, fleshy, round to kidney-shaped leaves with 3-7 lobes
- Stalk attaches to the base of the leaf at the margin, unlike other native pennywort species with stalks that attach to the center of the leaf's underside
- Shorter flower clusters of 5-10 flowers with greenish- to yellowish-white to purplish petals
- Native to North America

Growth Period: rapid growth early spring to early summer, slow growth through winter; flowers March - August

Habitat: pond and lake margins, marshes, low swamps, slow streams, irrigation and drainage ditches